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Firm Strategies behind the Establishment of Licensing Agreements

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Introducción

Los contratos de licencia son acuerdos entre empresas a través de los cuales el propietario de la tecnología (licenciante) permite a otra empresa (licenciatario) producir, vender y utilizar una tecnología sin transferir su propiedad a cambio de una compensación económica (Granstrand, 1999).

En las últimas dos décadas, los acuerdos de licencia han experimentado un crecimiento sin precedentes (Kamiyama , Sheehan, y Martínez, 2006; Zuniga y Guellec , 2009). Hoy en día, representan una de las opciones disponibles más importantes para la transferencia de tecnología (Anand y Khanna, 2000b; Arora y Fosfuri , 2003) .

Debido a la creciente importancia de los contratos de licencia he considerado que entender sus determinantes y consecuencias, así como las situaciones en las cuales las empresas tienen más probabilidades de beneficiarse/salir perjudicadas con su concesión resulta fundamental para tomar una decisión de licencia informada.

Los acuerdos de licencia se caracterizan por tres peculiaridades que permiten a las empresas utilizarlas de forma estratégica y que, a la vez, hacen interesante su estudio.

En primer lugar, la mayoría de las veces la concesión de licencias implica un *trade-off* entre sus beneficios y sus costes potenciales. Por un lado, la empresa licenciante aumenta sus beneficios en la cantidad establecida en el contrato (*Efecto Beneficio*, efecto a corto plazo). Por otro lado, las empresas licenciantes pueden perder cuota de mercado o ver reducidos sus márgenes de beneficio debido a la mayor competencia en el mercado del producto creada por el nuevo licenciatario (*Efecto Disipación del Beneficio*, efecto a largo plazo) (Arora y Fosfuri, 2003; Fosfuri, 2006). Por lo tanto, las decisiones de concesión de licencias exigen cautela: requiere sopesar las ganancias en el corto plazo frente a posibles daños en el largo plazo y sólo conceder una licencia si el *Efecto Beneficio* supera el *Efecto Disipación del Beneficio*. Las empresas que subestiman los efectos negativos de largo plazo están poniendo sus ventajas competitivas en riesgo. Un ejemplo que evidencia lo anterior es Hitachi. Antes de 2003, Hitachi era una de las empresas que más tecnología licenciaba. De hecho, en 2002 la compañía presentó ingresos por licencias por un valor de 43 millones de yenes japoneses (414.474 dólares[1] americanos). Sin embargo, esta estrategia permitió que sus licenciatarios en China y Corea mejoraran su tecnología rápidamente, amenazando de ese modo su ventaja competitiva. De esta forma, en el año 2003, Hitachi se vio obligada a restringir su política de licencias (Kamiyama et al. 2006).

[1] Tipo de cambio a 5 de abril, 2014

En segundo lugar, los contratos de licencia son privados y confidenciales y las normas contables no exigen a las empresas reconocer los ingresos por licencias de manera separada en su cuenta de resultados. De hecho, en la mayoría de los casos, los ingresos por licencias se contabilizan bajo el nombre de *"otros ingresos"*, lo que hace imposible distinguir el beneficio económico generado por las mismas. En consecuencia, cuando una empresa recibe ingresos por la concesión de licencias, los observadores externos sólo perciben un aumento en los ingresos. Esta incapacidad para identificar de manera inmediata la concesión de licencias proporciona a las empresas la oportunidad de inflar sus ganancias actuales y de beneficiarse de ellas durante algún tiempo. Por ejemplo, IBM consiguió retrasar el reconocimiento de su crisis financiera hasta finales del año 1991 porque llevaban "aumentando" sus ingresos a través de la concesión de licencias desde 1988 (Teece, 2003).

Por último, los mercados donde se transfiere la tecnología se caracterizan por asimetrías de información entre las partes, dificultades de negociación, la falta de un mecanismo establecido para fijar los precios de la tecnología y la incertidumbre sobre la validez y la aplicabilidad de la tecnología en otra empresa (Arora y Gambardella, 2010). En consecuencia, la mayor parte de las veces, las partes implicadas en el acuerdo no de manera igualitaria los beneficios totales que han sido generados. Por lo tanto, el resultado de la negociación dependerá de las características específicas de la empresas, del sector, y de la industria en la que se firma cada acuerdo de licencia.

Motivado por la diferente naturaleza de estas características a lo largo de esta tesis he decidido analizar las estrategias empresariales que podrían estar detrás de la firma de los acuerdos de licencia. En particular, esta tesis se centra en entender los factores determinantes y las consecuencias detrás de la concesión de licencias a otras empresas. Durante los tres ensayos, un tema recurrente ha sido la relación entre la concesión de licencias y los resultados empresariales (tanto antes como después de su firma). Además, también he tratado de clarificar los factores que afectan a los beneficios y costes asociados con la decisión de licenciar (*licensing trade-off*) y he analizado cómo el poder de negociación del que licencia afecta a sus beneficios obtenidos.

El primer ensayo demuestra de manera empírica que los directivos, bajo la presión de alcanzar las previsiones de los analistas financieros respecto a los beneficios, firman contratos de licencias con otras empresas como un medio para aumentar las ganancias a corto plazo. Sin embargo, como los contratos de licencia implican siempre un *trade-off*, las empresas que han aumentado el número de contratos de licencias para aumentar sus beneficios en el corto plazo (*Efecto Beneficio*) también ven reducida su cuota de mercado en el largo plazo (*Efecto Disipación del Beneficio*). Para testar las hipótesis he utilizado una muestra de 107 empresas americanas durante el período 1998-2009. Los resultados de este estudio son principalmente tres. En primer lugar, se confirma que las empresas tienen más probabilidades de aumentar la venta de sus contratos de licencias cuando no fueron capaces de alcanzar las previsiones de los analistas financieros en el ejercicio anterior. En segundo lugar, se pone en evidencia que las empresas que han aumentado el número de contratos de licencias con respecto al año anterior, presentan una cuota de mercado decreciente en los dos años siguientes al de la venta de la licencia. Finalmente, se muestra que esta tendencia decreciente de la cuota de mercado es más fuerte para las empresas que habían firmado contratos de licencia y no fueron capaces de alcanzar las previsiones de los analistas financieros en el año anterior que para las empresas que han incrementado el número de contratos de licencia y que habían superado el umbral previsto por los analistas financieros.

El segundo ensayo propone y prueba empíricamente un modelo que explica cómo la concesión de licencias tecnológicas a otra empresa afecta a la cuota de mercado del licenciante. Mientras que varios estudios han analizado el llamado *"Efecto Disipación del Beneficio"*, no hemos podido encontrar en la literatura ninguna aplicación empírica. Para testar nuestras hipótesis nos hemos centrado en una muestra de 163 licenciantes dentro de la industria farmacéutica americana durante el período 1984-2004. Los resultados de este estudio demuestran que las empresas que conceden licencias de tecnología que pertenecen a la actividad principal de la empresa experimentan un mayor "*Efecto Disipación del Beneficio*". Además hemos demostrado que esta relación se encuentra moderada por el tamaño del licenciatario (mayor tamaño, mayor efecto disipación resultante de licenciar tecnología clave) y por la superposición tecnológica entre el licenciante y el licenciatario (menor superposición, menor efecto disipación resultante de licenciar tecnología clave).

El tercer ensayo analiza cómo el valor de mercado de las empresas licenciantes varía en el momento en el que se anuncia un acuerdo de licencia. En este estudio propongo que la capacidad del licenciante para apropiar beneficios es una función de su poder de negociación (determinado por su situación financiera y por las asimetrías de información en el momento de la firma del contrato) y por el coste potencial de imitación al que se enfrenta tras haber licenciado (determinado por su posición en el sector). Como el poder de negociación en cada situación determina el éxito del licenciante a la hora de imponer requisitos, asumo que éste también debería influir positivamente en la capacidad de apropiación de la empresa en términos de valor de mercado. Sin embargo, el coste de imitación debería tener un efecto negativo en la capacidad de apropiación de la empresa licenciante. Para testar las hipótesis de este ensayo me he centrado en una muestra de 260 acuerdos de licencia que fueron anunciados en prensa durante el periodo 1998-2009. Los resultados sugieren, en primer lugar que las empresas que tienen problemas de liquidez en el corto plazo generan un impacto menor en su cotización bursátil que las empresas que no tienen limitaciones financieras. Además, las empresas licenciantes que firman un contrato de licencia en una situación de reducida asimetría de información (mismo sector) generan un mayor impacto en el mercado de valores que las empresas que lo hacen en condiciones donde hay más asimetrías de información (distinto sector). Finalmente, las empresas licenciantes que son líderes en su sector generan un impacto menor en bolsa que las que no son líderes (seguidoras).

Con todo lo comentado, las principales contribuciones académicas y prácticas de los tres ensayos son las siguientes:

El primer ensayo contribuye a la literatura de innovación, demostrando que la presión para alcanzar las previsiones de los analistas financieros puede ser también un factor que explique la concesión de contratos de licencia. Asimismo, este estudio también contribuye a la teoría de la gestión miope de dos maneras. Por un lado, demuestra que la concesión de licencias podría ser utilizada como una actividad para aumentar los ingresos actuales en detrimento de la reducción de la cuota de mercado en los años siguientes. Por otro lado, amplia el horizonte temporal de las actividades miopes, es decir, las actividades que inflan los beneficios en el corto plazo a costa de los beneficios a largo plazo.. Basándome en la literatura que conozco en este campo, los investigadores se han centrado en analizar las estrategias que los directivos siguieron en el período anterior a no alcanzar las previsiones. Sin embargo, este estudio sugiere que los directivos de las empresas también pueden seguir estrategias que no tienen un efecto inmediato. Desde un punto de vista práctico, este ensayo menciona varias ideas que las empresas deberían de tener en cuenta. En primer lugar, advierte de que es necesario educar a los directivos acerca de las posibles consecuencias a largo plazo de la concesión de licencias. Es importante analizar la decisión de conceder licencias con precaución, centrándose en los beneficios netos de la estrategia. Además, sugiere que el diseño de la remuneración de los directivos debería ser establecido de forma que les motivase a participar en proyectos eficientes en el largo plazo (que maximicen la suma de los beneficios futuros descontados). Asimismo, los resultados también ponen en evidencia las consecuencias negativas de una estructura empresarial centralizada. Si las empresas tuvieran un departamento de licencias independiente que se encargara de tomar esas decisiones y cuyos incentivos fueran diferentes a los del departamento económico, los directivos no podrían firmar contratos de licencias sólo para beneficiarse de las ganancias a corto plazo. Por último, sería necesario que la sociedad meditara acerca de las consecuencias negativas de imponer un objetivo de ganancias a los directivos. Claramente, esta presión no permite que los directivos se concentren en estrategias de largo plazo y lo único que consigue es que se que ponga en juego la productividad de las empresas a largo plazo y, a su vez, la de toda la sociedad.

La principal contribución del segundo ensayo reside en el desarrollo de un modelo respecto a uno de los supuestos centrales de los mercados de la tecnología (el efecto de disipación del beneficio), que no ha sido probado de manera empírica. Por otra parte, este ensayo integra ideas clave de estudios anteriores de una manera novedosa para desarrollar y refrendar las hipótesis. En primer lugar, nos basamos en la idea de que el efecto de la disipación de los beneficios tiende a ser mayor para las empresas con activos complementarios en el mercado de productos. Posteriormente, incorporamos en nuestro modelo el supuesto de que los licenciatarios difieren en su capacidad para explotar comercialmente la tecnología licenciada afectando, en consecuencia, al efecto disipación de los licenciantes. En tercer lugar, aplicamos la idea de la proximidad tecnológica entre las partes contratantes. Igualmente, con el objetivo de superar la falta de información con respecto a los ingresos generados por cada contrato de licencia, este estudio propone utilizar la cláusula de "*mínimo royalty garantizado*" como una proxy para el *"Efecto Beneficio"*. Esta cláusula garantiza que la empresa que concede la licencia recibirá compensación monetaria independientemente de los resultados del licenciatario al explotar la tecnología.

Finalmente, el último ensayo mejora la comprensión sobre la capacidad de los licenciantes para apropiar los beneficios resultantes. Mediante el análisis de las situaciones que generan mayores/menores impactos en el mercado de valores, este estudio ofrece a los directivos una orientación en sus decisiones estratégicas. En primer lugar, este estudio evidencia que el mercado de valores responde mejor a una concesión de licencias cuando el licenciante no tiene problemas de liquidez. En segundo lugar, muestra que el mercado de valores responde mejor a una decisión de concesión de licencias si el licenciatario pertenece al mismo sector que el licenciante, pero también que este aumento de la cotización bursátil sólo se produce si el riesgo de imitación resultante de la concesión de licencias no es demasiado alto. Para los directivos de las empresas que son líderes de su sector, este estudio revela que la concesión de licencias tiene un impacto casi inexistente en el mercado de valores. En cambio, este estudio sugiere que los directivos de las empresas que son seguidoras aumentarán notablemente su valor de mercado si conceden licencias, especialmente si además pertenece al mismo sector que el licenciatario. Por último, este ensayo revela que la mejor situación para apropiar los beneficios resultantes de conceder licencias, en términos de valor de mercado, es licenciar a una empresa que pertenece al mismo sector, mientras el licenciante sea un seguidor.

Introduction

Licensing contracts are agreements between companies through which the owner of the technology (licensor) allows another company (licensee) to make, sell and use a technology in exchange of an economic compensation, without transferring its ownership rights (Granstrand, 1999).

Over the last two decades, licensing agreements have experienced an unprecedented growth (Kamiyama, Sheehan, & Martínez, 2006; Zuniga & Guellec, 2009; Conti et al. 2013). Nowadays, they represent one of the most important options available to transfer technology (Anand & Khanna, 2000b; Arora & Fosfuri, 2003).

Due to the increasing importance of the licensing phenomenon, it has become more and more crucial to understand its determinants and consequences, as well as the contingencies under which companies are more likely to benefit/lose from licensing. There are three complex peculiarities that characterize licensing agreements and that make them not only a valuable strategic tool, but also a challenging endeavor that calls for informed decision.

First of all, most of the times licensing implies a trade off. On one hand, companies expect to reap benefits by increasing the licensing revenues (*Revenue Effect,* short term effect). On the other hand, they might lose market share or suffer from lower price margins because of the additional competition in the product market created by the new licensee (*Rent Dissipation Effect*, long term effect) (Arora & Fosfuri, 2003; Fosfuri, 2006). Therefore, licensing decisions demand caution to balance short-term earnings against possible long-term harms. Firms that underestimate the negative effects put their competitive advantages at risk. An example that puts this argument in evidence is the one of Hitachi. Before 2003, it was one of the companies that most actively licensed out technologies. It presented licensing revenues of JPY43 billion (414.474 US dollars[2]) in 2002. But this aggressive licensing strategy helped licensees in China and Korea improve their technology rapidly, threatening Hitachi's competitive advantage. As a result, Hitachi had to restrict its licensing policy by 2003 (Kamiyama et al. 2006).

Secondly, licensing contracts are private and confidential, and accounting rules do not require companies to recognize licensing revenues as a separate item in corporate reports. In fact, most of the times, licensing revenues appear in the income statement under the name "other income", what makes difficult to disentangle their economic benefit. In consequence, when a company receives licensing revenues, external observers and stakeholders only perceive an increase in earnings. The inability to immediately identify licensing practices provides managers with an opportunity to inflate current earnings and benefit from it for some time. For instance, IBM delayed the recognition of a crisis until the end 1991 because they were "increasing" earnings through licensing since 1988 (Teece, 2003).

Finally, markets for technology are characterized by information asymmetries between parties that lead to incomplete contracts, bargaining difficulties (due to the risk of sharing information before signing the contract), lack of any established mechanism for pricing technologies and uncertainty about the validity and applicability of the traded technology (Arora & Gambardella, 2010). As a consequence, most of the times the parties do not equally appropriate the profits generated by the agreement. The output of any licensing negotiation typically depends on the specific characteristics of the company, sector, and industry in which it takes place.

Motivated by these complexities, I have decided to focus on the study of the strategies companies potentially use behind the signing of licensing agreements. This thesis consists of three essays that aim to understand the determinants and the consequences behind a company's decision to license out its intellectual property to other companies. Throughout the three essays, a recurrent theme is the relationship between licensing strategy and firm performance (both before and after licensing). Furthermore, I investigate the factors affecting the licensing trade-off (i.e. the balance between benefits and costs associated with a licensing decision) and how the licensor's bargaining power affects the returns from licensing.

The first essay empirically considers whether managers, under the pressure to attain the analyst's forecasts, license out intellectual property as a means of increasing short-term earnings. It also assesses the trade-offs implied in this decision: companies that license out their technology in order to increase their benefits in the short term (*Revenue Effect*) are likely to harm their market share in the long run (*Dissipation Effect*). The hypotheses have been tested through the study of a sample of 107 U.S. companies during the period 1998-2009 (1,281 observations). The findings of this study are three-fold. In the first place, results confirm that companies are more likely to license out their intellectual property when they were not able to achieve analyst's forecasts. Secondly, companies that have increased the number of licensing out contracts with respect to the previous year present a decreasing market share trend in the following two years. Finally, the decreasing market share's trend is stronger for companies that license out their technology and are not able to achieve analyst's forecasts than for companies that overcome the earnings threshold.

The second essay proposes and tests in an empirical manner a model to explain the effect of technology licensing on the licensor's market-share. While several studies have discussed the so-called dissipation effect related to technology licensing in theoretical terms, few have examined it empirically. This essay examines this effect on a sample of 163 licensors involved in licensing contracts within the U.S. pharmaceutical industry during the period of 1984 – 2004. This study finds that licensing core technologies generates an increase in competition in the product market, resulting in a rent dissipation for the licensor. In addition, it demonstrates that this relationship is moderated by the licensee's size and by the technological overlap between the licensor and the licensee. The essay thus finds broad support for the theoretical arguments.

The third essay investigates how a licensor's market value varies at the time it announces a licensing agreement. It states that licensors' appropriation capacity (proxied by licensors' market value) is a function of their bargaining power (determined by their financial situation and information asymmetries at the time of contract signing) and the potential cost of imitation faced by licensors (determined by their position in the sector). As bargaining power in each situation should determine licensors' success, it should also enhance licensors' appropriation capacity in terms of market value. However, the cost of imitation should have a negative effect on licensors' appropriation capacity. These hypotheses were tested on a novel dataset that captures the stock market responses to 260 licensing agreements in press releases over a twelve-year period: 1998-2009. The results of the event study suggest three key findings: 1) companies with cash constraints appropriate fewer benefits from licensing than companies that have no cash flow limitations; 2) companies that license out under low information asymmetries (same sector) appropriate more benefits from licensing than companies facing high information asymmetries (different sector) and 3) licensors that are industry leaders achieve fewer benefits than those that are followers.

Regarding the academic and practical contributions of the thesis, I would like to point out the following:

The first essay contributes to the innovation literature by extending the range of antecedents and outcomes of outward licensing. First, it shows that the pressure to achieve analysts' forecasts is also a potential determinant of the decision to license-out technology. Second, it provides first empirical evidence of the negative long-term consequences of licensing (Rent Dissipation Effect). In addition, it contributes to the Myopic Management Theory in two ways. On one hand, it demonstrates that licensing out technology could be used as a real activity that increases current earnings at the expense of reducing market share in the incoming years. On the other, it amplifies the temporal horizon of the real activities. To the best of my knowledge, researchers have focused on the strategies that managers took in the period previous to the negative earnings surprise. However, this paper suggests that managers can also follow strategies that do not have an immediate effect. From a practical point of view, this study gives some insights into what companies should take into account when designing their technology strategies. It establishes that it is necessary to educate managers about the potential long-term consequences of outward licensing. It is important that they analyze the decision to license with caution, focusing on the net benefits of the strategy. Furthermore, caution is required to the way in which managerial compensation is established in order to motivate managers to engage in projects that maximize the sum of discounted future profits. In addition, the results also highlight the negative consequences of a centralized licensing structure. If companies had an independent licensing department in charge of making such decisions and whose incentives were different to those of the economic department, managers could not license out their technology just to benefit from the inflated current earnings. Finally, this study invites for a critical reflection about the negative consequences of imposing an earnings target on managers. Clearly, this pressure does not allow managers to focus on long term strategies, putting at stake the long term productivity of companies and, in turn, that of the whole society.

The main contribution of the second essay lies in the development of an empirically testable model concerning one of the central assumptions of the literature on markets for technology (the dissipation effect), which had not been previously tested against empirical data. Furthermore, this essay integrates the insights from various theoretical streams in a novel way. First, we draw on the existing proposition that the dissipation effect tends to be higher for firms with downstream assets in the product market. Subsequently, we incorporate in our model the aspect that licensees differ in their capacity to commercially exploit the licensed technology, which naturally impacts in the licensor's rent dissipation. Finally, we apply the idea of technological proximity to conclude that the dissipation effect resulting from licensing out core technologies will be weaker in a context where the technological overlap between the parties is low. Furthermore, in an attempt to overcome the lack of information regarding the revenue generated by each deal, this study proposes to use the minimum guarantee royalty clause as a proxy for the revenue effect. This clause ensures that the licensor will receive monetary compensation regardless of licensee's performance and it is also a way to guarantee that the licensee will not use the licensing agreement to avoid or delay the introduction of a competitive technology to the market.

Finally, the last essay improves the understanding of licensors' appropriation capacity through an analysis of company, sector, and industry factors. By analyzing the situations that generate stronger/weaker impacts in the stock market, this study offers managers some guidance in their strategic decisions. First, this study shows that the stock market responds better to a licensing decision when the licensor has not cash constraints than when the company is having financial limitations. Second, it evidences that the stock market responds better to a licensing decision if the licensee belongs to the same sector than the licensor but that this significant stock market increase occurs only if the risk of imitation resulting from licensing out is not too high. For managers of firms that are leaders of their sector, this study reveals that the impact of licensing out on the stock market is almost nonexistent. Consequently, for leading companies, it is better not to license out unless the licensing payments overcome the potential cost of imitation. On contrary, this study suggests to the managers of companies that are followers that they will have a strong impact in the stock market as a consequence of licensing out their technology. Finally, this essay reveals that the best situation to appropriate benefits in terms of market value is to license out the technology to a company that belongs to the same sector while being a follower.

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CHAPTER 1 - Licensing Out as a Real Activity to engage in Myopic Management

1.1. Introduction

In the past two decades, licensing agreements have grown at an unprecedented rate, making their management a core competence issue, especially for high-tech companies (Kamiyama et al., 2006; Zuniga & Guellec, 2009; Conti et al. 2013). To facilitate knowledge transfers, companies thus establish licensing departments or publish the technology available for license online.[3] The main reason for these expanded activities is the revenue that licensing generates. In one survey, 51% of European companies and 53.6% of Japanese companies noted that their main motivation for licensing out their technology in the previous three years was revenue (Zuniga & Guellec, 2009). However, licensing has negative effects too; companies might increase their revenues (net of transaction costs), but they might lose market share or suffer from lower price margins because of the additional competition in the product market created by the new licensees (Arora & Fosfuri, 2003; Fosfuri, 2006). Therefore, licensing decisions demand caution to balance short-term earnings against possible long-term harms. Firms that underestimate the negative effects put their competitive advantages at risk.[4]

At the same time, financial analysts exert increasing influences on companies' strategies, leading to disproportionate consequences for firms that miss forecasts, even by a small amount.[5] In turn, managers face extra pressure and incentives to manipulate current earnings. A survey of CFO (Graham et al., 2005) reveals that they attend carefully to meeting earnings thresholds and are willing to inflate current earnings to achieve them, mainly using real activities rather than accruals.

Motivated by these two seemingly unrelated trends, this article sheds light on the relationship between a company's financial situation and its licensing strategy, by examining whether managers license out technology to inflate current earnings and determining the long-term

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[3] See, for example, Dow Chemical: http://www.dow.com/licensing/; Kimberly Clark: http://www.merck.com/licensing/home.html; and Merck & Co: http://www.merck.com/licensing/home.html.

[4] Before 2003, Hitachi licensed out a lot of technology; in 2002, the company earned licensing revenues of JPY43 billion. But this aggressive licensing strategy helped licensees in China and Korea improve their technology rapidly, threatening Hitachi's competitive advantage. Thus by 2003, Hitachi chose to restrict its licensing policy (Kamiyama et al. 2006).

[5] Oracle's stock price declined by 29% in December 1997 when it failed to achieve analysts' forecasts by a mere $.04 (though its results were 4% above EPS for the same quarter in the previous year) (Skinner & Sloan, 2002). Procter & Gamble lost 30% of its stock price when it warned that it would not beat analysts' forecasts in the first quarter of 2000. A similar warning before the second quarter led to another 10% reduction in the stock price, as well as the CFO's dismissal (Duncan, 2001).

consequences for companies that make licensing decisions in response to the pressure to meet analysts' forecast. Managers who feel pressured to attain analysts' forecasts have incentives to inflate current earnings and thus likely engage in myopic management. These myopic managers put more emphasis on the short term than the long run, such that when they make their licensing decisions, myopic managers likely overestimate the revenue (short-term) effect while underestimating the dissipation (long-term) effect. Such overestimates are common, as exemplified in a declaration by Daniel M. McGavock, the managing director of the intellectual property consulting firm Intercap: *"On one hand, you don't want to abandon your patents' ability to exclude competitors from your market. But, on the other hand, you could be talking about hundreds of millions of dollars in new revenue from strategic licensing, not to mention a host of strategic benefits"* (Kline, 2003, p.90). This distortion leads managers, already under pressure to inflate short-term earnings, to license out more technology than is optimal, offer inappropriate technology, or accept inappropriate conditions, all of which may have negative long-term consequences.

The tests of these predictions rely on a panel of 107 U.S. high-tech companies during 1998–2009 (1,281 observations). The licensing data came from four sources: Prompt Database, Google, Highbeam Research, and SDC Platinum. Through an extensive search, I identified 1,729 licensing agreements,[6] including 840 licensing in, 716 licensing out, and 173 cross licensing contracts. Following Bushee (1998), I estimated a logit model to explain the probability of increasing the number of licensing out contracts from period t – 1 to period t, using as the main independent variable a dummy that captures whether the company achieved analysts' forecasts in t – 1. These results show that companies tend to license out their intellectual property when they failed to achieve analysts' forecasts in the previous year.

In addition, I created five different groups and compared the market share evolution of each group for two years after licensing out, versus the market share evolution of the rest of the sample. When companies increased the number of their licensing out contracts compared with the previous year, they suffered decreasing market share trends in the following two years. This decreasing market share trend was stronger among companies that licensed out their technology and still failed to achieve analysts' forecast than it was among companies that licensed out and thereby achieved the earnings threshold. However, the market share decrease is independent of companies' financial situation.

With these findings, this study contributes to innovation literature that examines the strategic drivers of technology licensing. Prior research cites economic and strategic motivations for licensing (Gallini, 1984; Katz & Shapiro, 1985; Rockett, 1990; Shepard, 1987); I show that the

[6] Only 154 licensing agreements were collected from SDC Platinum during the period of study for this sample.

pressure to achieve analysts' forecasts is another potential determinant. In relation to myopic management theory, I also propose a new activity that can inflate current earnings. Prior research had identified other activities that managers adopt to engage in myopic management (Aaker, 1991; Chapman & Steenburgh, 2009; Moorman & Spencer, 2008; Roychowdhury, 2006); the present study shows that licensing out technology offers a real activity that increases current earnings, at the expense of reducing market share in subsequent years.

The next section thus presents the theoretical background for myopic management and licensing. Section 2 develops the hypotheses; Section 3 describes the methodological analysis. After discussing the results in Section 4, I conclude in Section 5.

1.2. Theory

Previous research into markets for technology has shown that licensing agreements have increased remarkably in recent decades, mainly due to the revenue they generate (Gambardella et al., 2007; Robbins, 2009; Zuniga & Guellec, 2009). Myopic management literature also has demonstrated that the severe consequences of missing analysts' forecasts have altered the way managers run companies: They are short-term minded and have incentives to manipulate earnings, even at the expense of long-term performance (Degeorge et al. 1999; Graham et al. 2005; Mizik, 2010). The combination of these two apparently unrelated trends suggests that licensing out offers a real activity used to inflate current earnings and achieve analysts' forecasts, despite its negative long-term consequences in terms of market share.

1.2.1. Licensing Theory

Modern companies have moved from protecting their knowledge completely to licensing it (Vishwasrao, 2004; Yanagisawa & Guellec, 2009). Licensing represents a critical route for technology transfer, and companies increasingly seek efficient corporate structures that can facilitate such knowledge transfer (Arora et al., 2013). Yet the most important motivation for licensing out technology is the revenue it generates, equal to the present value of the fixed fee or the royalties that licensees pay to the licensor. Gambardella et al. (2007), Robbins (2009), and Zuniga and Guellec (2009) confirm that earnings revenue is the main motivation for companies that license-out technology.

However, the importance of licensing revenues actually depends on two features. First, transaction costs could make licensing less profitable. In general, licensing contracts are distinguished by high search costs, incurred as the firm searches for suitable licensees and/or licensors, as well as information asymmetries between parties that lead to incomplete contracts, bargaining difficulties reflecting the risk of sharing information before signing the contract, and a lack of any established mechanism for pricing technologies. Second, the rent profit dissipation effect seemingly could overwhelm licensing revenues and even produce negative long-term consequences for the company licensing out the technology. Through licensing, licensors grant access to secrets about their technology and allow licensees to use it. By internalizing and understanding how the licensed technology works, licensees can invent around the technology, imitate licensors, and compete directly with them in the product market, which would reduce the licensor's market share and price–cost margin. The rent profit dissipation effect reflects the reduction in the licensor's benefits, as a consequence of additional competition in the product market created by the licensee (Arora & Fosfuri, 2003; Fosfuri, 2006). To really generate benefits from licensing, companies thus should license their technology if the revenue effect (net of transaction costs) is greater than the rent profit dissipation effect.

To limit the extent of the latter effect, previous research suggests licensing out technology based on scientific knowledge (Arora & Gambardella, 1994), intellectual property related to non-core technologies and targeted toward geographically separated markets (Granstrand et al. 1997), and intellectual property that refers to general technologies (Bresnahan & Gambardella, 1998), as well as when patent protections are strong (Arora & Ceccagnoli, 2006; Cohen et al., 2000), competition in the product market is high (Arora & Fosfuri, 2003), and the firm's market share is small (Fosfuri, 2006). However, additional competition is nearly always a threat for a company (Fosfuri, 2006).

Prior research has also suggested some strategic incentives for licensing. Gallini (1984) demonstrates that licensing can lead to technology leadership, because if an established company licenses out its technology to potential entrants, it reduces their incentives to develop their own, potentially competing technology. Shapiro (1985) further argue that licensing can support collusive agreements. If the licensor chooses an appropriate royalty rate for the licensee, prices increase and can stimulate the formation of a cartel (Shapiro, 2001). Farrel and Gallini (1988) also note that licensing might establish a second source mechanism and thus encourage purchase. If the new technology is complex and produced by only one company, potential buyers may be reluctant to buy it, for fear that the company cannot fully meet demand. Finally, Rockett (1990) shows that through licensing, a company can choose its competitors. If an established firm licenses its technology to a weak rival, it can crowd the market and block entry by a stronger competitor.

1.2.2. Myopic Management Theory

Effective management requires a long-term focus, prioritizing projects that generate the greatest net present value (Mizik, 2010). However, the importance the market grants to current earnings forces managers to adopt strategies that result in immediate pay-offs (Dechow, 1994; Degeorge et al., 1999). Usually managers' compensation and evaluations are based on the company's current stock price (Mizik, 2010), which in turn depends on whether the firm achieves three earnings benchmarks: zero earnings, prior comparable period's earnings, or analysts' forecasts (Degeorge et al., 1999). The pressure to meet these thresholds gives managers incentives to manipulate their results to inflate current earnings. The pressure even has changed the distribution of earnings reported: Few firms report losses, and the majority cite small profits (Dechow et al., 2003). In a survey conducted by Graham et al. (2005), financial executives declared that to avoid negative surprises, they were willing to inflate current earnings and preferred to do so through real activities rather than accruals. The objective of both strategies is to inflate current earnings, but the implications and costs differ greatly. Manipulating discretionary accruals aims to adjust the time at which the firm realizes its earnings, not to modify the quantity or temporal flow of profits. Real activities instead entail engaging in myopic management, which means undertaking activities to inflate current earnings at the expense of long-term firm value. Managers prefer to manipulate earnings through real activities for two main reasons. First, auditors can detect accrual earnings management more easily than real activities manipulation, in that "While auditors can second-guess the firm's accounting policies, they cannot readily challenge real economic actions to meet earnings targets that are taken in the ordinary course of business" (Graham et al., 2005, p. 17). Second, inflating earnings with accrual manipulation alone is risky, because the amount of potential manipulation after the end of the fiscal period is limited: "If reported income falls below the threshold and all accrual based strategies to meet it are exhausted, managers are left with no options because real activities cannot be adjusted at or after the end of the fiscal reporting period" (Cohen & Zarowin, 2010, p. 7). Therefore, to inflate current earnings and meet analysts' forecast, managers use the "safest" method, but also the one that can lead to more negative consequences in the long run.

Prior research on myopic management mainly concentrates on ways to reduce R&D investments and which factors determine this practice. In particular, managers reduce their R&D expenditures when they cannot ensure positive earnings for the next year (Baber et al., 1991), when their retirement is impending (Cheng, 2004; Dechow & Sloan, 1991), when institutional ownership is not very high (Bushee, 1998), and when managers must repurchase stock to avoid dilution of their earnings per share (Bens et al. 2002, 2003). But managers also engage in other real activities to increase short-term earnings. As Aaker (1991) shows, companies reduce their marketing expenditures to inflate their profits temporarily; Cohen and Zarowin (2010) specify that managers reduce their advertising spending. Bartov (1993) and Herrmann et al. (2003) also find managers who sell fixed assets strategically, to benefit from acquisition cost principles. Jackson and Wilcox (2000) cite examples of managers who provide sale price reductions in fourth quarters, whereas Hribar et al. (2006) note firms that use stock repurchases. According to Roychowdhury (2006), managers use price discounts and zero financing strategies, overproduce and reduce their discretionary expenses. Moorman and Spencer (2008) show that managers delay the introduction of innovations; Dechow and Shakespeare, (2009) find that companies record securitizations as collateralized borrowings at the end of the month.

Despite such established evidence of myopic management practices, few studies quantify their financial impacts. Pauwels (2004) finds that sales promotions imply negative long-term effects for firm value, and Gunny (2005) links myopic practices to lower returns on assets in the subsequent year. In Mizik and Jacobson's (2007) study, two years after reducing their marketing expenditures, companies suffered negative earnings, such that by the fifth year, their market value had fallen by 25%. Mizik (2010) similarly notes that companies that have reduced their marketing expenditures suffer greater negative abnormal returns in the future than other companies. Chapman and Steenburgh (2009) also show that companies can use marketing to increase quarterly net income by up to 5% but that this strategy will invoke a 7.5% reduction of the next period quarterly net income. Such evidence emphasizes the trade-off associated with myopic management: The use of real activities increases short-term earnings and helps managers beat analysts' forecasts but also has negative long-term consequences for firm performance.

1.3. Hypotheses Development

As financial analysts become more influential and the consequences of missing forecasts grow more severe for companies (Skinner & Sloan, 2002), managers willingly engage in inefficient projects that threaten long-term firm performance but also help them avoid reductions in stock prices, keep their job, and enhance their reputation (Degeorge et al., 1999). Licensing out could be one such inefficient project, because companies must balance the increased revenue against the profit-dissipation effect. However, when managers confront pressures to beat analysts' forecasts, they likely place more emphasis on the short term and inflate current earnings at the expense of long-term performance.

Stein (1989) argues that for managers interested in manipulating short-term earnings, the easiest method is to reduce intangible asset expenditures, which are not separately recorded in the balance sheet and do not relate directly to production. These two characteristics also apply for licensing agreements. Usually, contracts are private and confidential, and accounting rules do not require companies to recognize licensing revenues as a separate item in corporate reports. When a company receives licensing revenues, external observers only perceive an increase in earnings; they cannot know if the reported earnings offer a valid proxy of future performance or if the earnings actually are coming at the expense of future profits. Licensing out intellectual property also does not affect short-term production. Even if companies license out their core technology to competitors, it takes time before they can observe any reduction in market share. This inability to identify licensing out practices immediately provides managers with an opportunity to inflate current earnings and benefit from it for some time.

Therefore, companies under pressure to beat analysts' forecasts likely overestimate the revenue effect and fail to make an efficient licensing decision. This distortion leads to licensing out more technology, without accounting for the negative long-term consequences. In other words, at the margin, licensing decisions that would not be undertaken in normal conditions seem attractive to managers under pressure, because they discount the future more.

H1. Companies are more likely to license out their intellectual property when they failed to achieve analysts' forecasts in the previous year.

Many researchers have studied motivations to license out technology, but few focus on its consequences. Theoretically, researchers agree on the existence of a negative, long-term, dissipation effect (Arora & Fosfuri, 2003; Gambardella et al., 2007; Zuniga & Guellec, 2009), though it has never been proven empirically. In general though, when companies license out their technology, they increase competition in the market and put their reputation at stake, with the risk of eroding market share and price margins (Arora & Fosfuri, 2003; Fosfuri, 2006). Prior research had proposed some strategies to limit this profit-dissipation effect (Arora & Fosfuri, 2003; Granstrand et al., 1997), but additional competition is inherently a threat to a company (Fosfuri, 2006).

Although licensing out might imply some negative consequences per se, companies that undertake the decision under pressure likely face even stronger consequences than other companies. That is, companies that increased their licensing out agreements in response to pressures to meet analysts' forecast suffer a greater market share reduction than companies that did not.

H2. Companies that have increased the number of licensing out contracts in a pressurized situation experience a stronger reduction in their market share in subsequent years than companies that have increased the number of licensing out contracts but not because of earnings pressure.

1.4. Data, Variables and Methodology

1.4.1. Sample and data

The empirical analysis is based on a sample of innovative U.S. companies. First, I focused on companies with many patents granted through the U.S. Patent and Trademark Office (USPTO) during 1990–2009.[7] Licensing is not an established practice for all companies and sectors, but because the main objective of this study is to analyze if companies license out their technology to inflate current earnings, I focus on 140 companies that possess the raw material (i.e., technological assets) to undertake such actions. Second, because of their rich information environment and the size of their market for technology, I narrowed the sample to U.S. companies. Licensing data is difficult to find, but this search process would be even more challenging in countries with inaccessible information about companies or small markets for technology. Third, I used annual data; many companies present quarterly losses, because of the intrinsic seasonality of their business, but I focus on yearly analysts' forecasts, which impose more pressure on managers, giving them more incentive to manage earnings.

The licensing data came from four sources: Prompt database, HighBeam Research, Google, and SDC Platinum. The first three sources use press news; the latter is an established licensing database. In Prompt, Google News, and HighBeam Research, I looked for licensing agreements through a keyword search for "licensing agreement" and the company name. In Prompt and HighBeam Research, I read all the resulting news; in Google I checked them until the twentieth page of results. After reading the news, I codified the agreements as "licensing out," "licensing in," or "cross licensing." Next, I matched these licensing agreements with those that I obtained from SCD Platinum. The final output was 1,729 licensing agreements: 840 license in, 716 license out, and 173 cross-licensing agreements. Finally, I matched the licensing data with

[7] I choose this nearly 20-year period in accordance with the normal length of a granted patent. If the USPTO granted a patent to a company in 1990, it would still be valid at the end of the study period.

Compustat financial data and analysts' forecast data from DataStream. These matches reduced the sample to 107 companies (1,281 observations[8]).

1.4.2.Variables

Dependent variable: increased licensing out

The dependent variable (*INCLICOUT*) is binary, equal to 1 if the firm increases its number of licensing contracts relative to the prior year and 0 if the firm maintains or decreases this number. Considering the distribution of the variable and its low variation, a binary approach can better capture the discrete change in the variable rather than a magnitude change. It also is unlikely that the magnitude of the change in the number of licensing agreements is a linear function of the difference between actual earnings per share and analysts' forecast earnings per share. Finally, the magnitude of the change is somewhat meaningless for this study: A company increasing its licensing contracts by x + 4 does not necessarily inflate its current benefits more than a company that increases the number of licensing out contracts by just x + 1.

Independent variable: earnings pressure

The independent variable (*EARNINGS_PRESSURE*) is an indicator, equal to 1 if the company did not beat analysts' forecasts in the previous year (or reaches exactly the same results the analysts predict) and 0 if the company surpassed analysts' forecasts in the previous year. To develop this variable, I first calculated the difference between the actual earnings per share and the mean of the consensus of analysts' forecasts during the fiscal year, before the results presentation. If this difference equaled 0 or was negative, managers experience more pressure to attain analysts' forecasts in the following year. I also created a dummy variable that equals 1 if the difference between the actual earnings per share and the mean of the consensus of analysts' forecast is null or negative, and 0 otherwise. The consequences of missing analysts' forecasts have become disproportionately severe, so an important distinction refers to achieving versus not achieving them.

Next, I measured earnings pressure in the previous year, because writing and executing a reliable licensing contract takes time. If a company wants to license out its technology, it must find an interested licensee, understand that licensee's technological base, figure out how to implement its technology, and negotiate in a context marked by asymmetric information, lack of experience, and technology that is difficult to describe or value. Establishing a licensing contract is not an easy task; as Razgaitis (2004) shows, 75% of the companies that want to license out their technology could not find licensees, and Gambardella et al. (2007) finds that

[8] 1,281 = 105 companies × 12-year period +1 company × 11-year period + 1 company × 10-year period.

7% of the technologies available remain unlicensed. Patenting companies also acknowledge that they would like to license out more but that it is difficult to achieve a successful licensing agreement (Zuniga & Guellec, 2009). According to Ali (2012), once licensing negotiations have begun, only 75% of companies successfully sign a contract. Thus licensing contracts as a real activity likely do not have immediate impacts on earnings. In addition, managers use multiple activities to inflate current earnings. When they first realize that they will fail to meet analysts' forecast, they use strategies that immediately inflate short-term earnings, such as decreasing R&D expenditures or offering price discounts. When these options become quickly exhausted, managers then turn to other activities for the next year. I anticipate that managers use licensing out to inflate current earnings after they have realized that immediate real activities are not enough to help them reach analysts' forecasts.

Control variables

In line with previous literature regarding myopic management, I define *INCCL* as a dummy variable that reflects the change in the current liabilities *(CL)* with respect to the prior year. This variable equals 1 if current liabilities[9] increase with respect to the previous year and 0 otherwise. When the ability to pay creditors and other short-term liabilities are at stake, managers worry more about the negative reactions of suppliers. Following Roychowdhury (2006), I thus expect that companies that increase (decrease) their liabilities with short-term suppliers sense more (less) incentive to increase the number of licensing agreements they enter to inflate current earnings. Next, I include *INCGO*, a dummy variable that reflects the change in the company's growth opportunities (*GO*) with respect to the previous year. This variable equals 1 if opportunities for growth increase from the previous year and 0 otherwise. Similar to Skinner and Sloan (2002), Hribar and Jenkins (2004), and Roychowdhury (2006), I define this variable as the ratio between the market value of equity[10] and the book value of equity.[11] Companies with more opportunities for growth suffer greater punishments from financial markets if they fail to meet their objectives and likely have more incentives to increase their licensing out contracts to inflate their short-term earnings.

To control for accumulated innovation capabilities, I use *INCACCPATGR*, a binary variable that reflects the change in the number of patents granted to a company compared with the previous year. Accumulated patents granted *(ACCPATGR)* is the number of patents accumulated over the years, at a depreciation rate equal to 15%. This variable equals 1 if the number of patents has increased over time and 0 otherwise. Companies with more accumulated patents seemingly should license out more technology.

[9] Compustat item 5.
[10] Compustat item 199 × Compustat item 25.
[11] Compustat item 60 × Compustat item 25.

To control for company size, I followed Bushee (1998) and used the logarithm of market value (*LOGMV)*.[12] In general, size proxies for the amount of information available about the firm and the likelihood that it faces cash constraints. Larger companies may have fewer opportunities to manage their earnings, because of the richer information environment and the relative lack of cash flow shortages. That is, large companies should license out less technology. To account for economic fluctuations, I include *INCGDPUS* as a dummy variable that reflects the change in the U.S. gross domestic product *(GDPUS)* with respect to the previous year, equal to 1 if U.S. GDP increased from the previous year and 0 otherwise.[13] As Bushee (1998) indicates, changes in GDP suggest growth in the overall economy and can proxy for increases in the level of technological progress. If GDP is increasing (decreasing), firms thus should have more (fewer) opportunities to license out their technology. In addition, I created seven sector dummy variables (*SIC*), six of which correspond to common SIC2 codes in the data and a seventh that represents the rest of the SIC2 codes. Table 3 provides a detailed description. Finally *YEART* corresponds to the year trend.

1.4.3. Methodology

To test the first hypothesis, I used a pooled logit model and estimated the effect of earnings pressure on the probability of increasing the number of licensing agreements; I also corrected for correlations among observations by clustering the standard errors at the firm level. For H2, I compared the market share evolution of several groups in two subsequent years with the remainder of the sample: (1) companies that increased their number of licensing out agreements but still were not able to achieve analysts' forecasts from the previous year, (2) companies that increased their number of licensing out contracts and thus achieved analysts' forecasts, (3) companies that did not increase their number of licensing out contracts and still achieved analysts' forecasts, (4) companies that did not increase their number of licensing out contracts and were not able to achieve analysts' forecasts, and (5) companies that had not achieved analysts' forecasts in previous years.

1.5. Results

Table 1 shows the main descriptive statistics and correlations. To offer deeper information, I report the variables in this table as levels, not binary variables. Thus companies establish an average of 0.502 licensing out contracts per year and are involved in a maximum of 13 licensing out contracts.

[12] The results remained invariant when using the logarithm of the number of employees.
[13] I tested for multicollinearity between the *INGGDPUSA* and *YEART* and found none.

[Insert Table 1 around here]

Tables 2 and 3 contain more detailed information about the licensing out contracts entered into by companies in the sample. In particular, Table 2 shows that most firms (73.77%) did not participate in any licensing out contracts; 10.62% engage in fewer than six per year. This finding corroborates the view of markets for technology as underdeveloped (Arora & Gambardella, 2010; Gambardella et al. 2007). Table 3 also provides evidence that companies in the electronic & other electrical equipment, machinery, and chemical & allied products industries license out more technology, such that 22.33% of the contracts in the sample refer to electronic companies, 19.59% belong to machinery firms, and 14.05% come from the chemical industry.

[Insert Table 2 and Table 3 around here]

Tables 4 and 5 contain descriptions of the differences between actual earnings per share and the mean of analysts' forecasts in the year before the result presentation. To clarify the distribution of the variable, I report it as a level and not as a binary variable. In Table 4, 55.89% of companies achieve positive results; 44.11% report losses. Table 5 shows that companies that surpass analysts' forecasts report maximum earnings per share that are 4.82 points higher than the threshold; companies that fail to beat them report maximum earnings per share that are 13.7 points lower. Similarly, Dechow et al. (2003) report that many firms report small profits and only a few admit losses.

[Insert Table 4 and Table 5 around here]

I also divided the sample into four categories, according to whether they (1) increased their licensing out contracts with respect to the previous year and (2) achieved analysts' forecasts in the previous year. As Table 6 shows, the percentage of companies that increased their number of licensing out contracts was greater among the group of companies that did not attain analysts' forecasts in the previous year (29.3%) than among companies that had met them (23.10%).

[Insert Table 6 around here]

The pooled logit regression in Table 7 includes the baseline Model 1 with only control variables and Model 2 with the earnings pressure variable. The interpretation of these logit coefficients is not straightforward, so in Table 8 I report the corresponding marginal effects, evaluated at the sample mean, and their standard errors. For example, in support of H1, Model 2 indicates that greater earning pressure in the previous year leads companies to increase the number of licensing out contracts, according to the positive, significant (at 1% level) coefficient of earnings pressure. The probability of licensing out increases from 22.75% (no earnings pressure) to 29.66% (earnings pressure).[14] The introduction of this variable also increases the pseudo R^2 value, from 0.117 to 0.128.

[Insert Table 7 and Table 8 around here]

Most control variables are significantly associated with the probability of greater licensing out. Increasing current liabilities *(INCCL)* with respect to the previous year relates positively to the probability of increasing the number of licensing out contracts, consistent with Roychowdhury's (2006) findings that when liabilities with short-term suppliers increase, managers have incentives to engage in myopic management. Increasing growth opportunities *(INCGO)* also relates positively to the probability of increasing licensing out contracts, in accordance with Skinner and Sloan's (2004) findings that companies with more growth opportunities have more myopic management incentives. Contrary to Bushee's (1999) findings though, the logarithm of market value *(LOGMV)* relates positively and significantly to the probability of increasing licensing-out contracts.[15] That is, companies with more market value likely increase the number of licensing out contracts they enter. Gross domestic product *(INCGDPUSA)* showed a positive relation with the probability of licensing out; when GDP is increasing, companies probably license out their technology. Finally, licensing out increases over time, corroborating the evidence that licensing has increased in recent years.

As a robustness check I also applied two alternative methods. First, the results of the conditional logit model remained significant when I used a binary variable (Table 9). Second, when I included the magnitude of the change in the number of licensing agreements as the dependent variable, the earnings pressure variable was significant, according to the ordinary least squares method (Table 10).[16]

[Insert Table 9 and Table 10 around here]

To corroborate previous findings (Bushee, 1998) and check the validity of proxy for earnings pressure, I next ran a pooled logit regression with "decrease R&D intensity" as the dependent variable. The only difference with the "increase licensing out" regression is that I measured earnings pressure in the current year. When managers suspect that they will fail to reach earnings thresholds, they often begin by cutting discretionary expenses (Mizik, 2010; Stein, 1989). Because cutting R&D expenditures has an immediate effect on earnings, I expect that

[14] The marginal effect after applying the logit model is 0.2275; the discrete change in *EARNINGSPRESSURE* from 0 to 1 is equal to 0.06909.
[15] If I use the logarithm of the number of employees as a proxy of size, the association is still positive. The coefficient is 0.127 in Model 1 and 0.133 in Model 2.
[16] The earnings pressure variable also was significant in the fixed effect model. This regression is available on request.

managers decrease R&D intensity to inflate current earnings and meet analysts' forecast. That is, they likely cut R&D before failing to meet analyst' forecasts.

Table 11 reports the coefficients that result from the logit regression; to facilitate their interpretation, Table 12 presents their marginal effects. These tables reveal that earnings pressure is positive and significant at the 5% level. The probability of decreasing R&D intensity increases by 0.0636 when I introduce the earnings pressure variable. That is, the probability that managers decrease R&D intensity jumps, from 45.6% to 52%. This analysis suggest two main findings: The proxy for earnings pressure is a appropriate measure to capture the pressure faced by managers, and reducing R&D intensity and increasing licensing out have different temporal effects, so managers might use both to inflate current earnings and improve the financial appearance of the firm.

[Insert Table 11 and Table 12 around here]

The main objective of my second hypothesis was to determine the market share evolution of companies that face earnings pressure and, in response, increased their number of licensing out contracts. Therefore, I distinguished observations in the sample that satisfy these two conditions (*SUSPECT*) from all other firms (*NO_SUSPECT*). Table 13 details the differences between these two subsamples, including the size of the companies, their investments in R&D, and their financial situations. This table thus reveals several insights: (1) suspect firms are larger on average than no suspect ones; (2) suspect firms invest more in R&D and have more patents available to license; (3) suspect firms establish 5 licensing out agreements at a maximum, whereas no suspect firms establish 13 at a maximum; (4) suspect firms have lower mean market value, book value, earnings before interest and taxes, total assets, net income, returns on assets, returns on earnings, returns on investments, common equity, cash flow from operations, and long-term debt than no suspect firms; and (5) suspect firms are characterized by higher mean current liabilities and short-term debt than no suspect ones. This description matches prior findings that show that larger companies invest more in own research and engage in less licensing out (i.e., with their higher market share, the profit dissipation effect would be worse for them). The no suspect firms enjoy a better financial situation, higher market value, and more cash flow from operations; suspect companies confront more short-term liabilities.

[Insert Table 13 around here]

Using these distinctions, I compared the evolution of market shares[17] for both subsamples over the subsequent two years, after the firms licensed out and increased the number of licensing out

[17] To compute market shares, I identified each sector by three-digit SIC code. The *DECREASEMARKETSHARE* dummy variable equals 1 if the market share decreased from the previous year and 0 otherwise.

contracts. As Table 14 shows, the percentage of no suspect observations that decreased their market shares was constant over the study period (57%), but it increased among the group of suspect companies (from 52% to 61%). In period t, suspect companies performed better than no suspect firms, such that 52% of suspect companies suffered decreased market shares, whereas 57% of the no suspect firms did. In period t + 1, suspect companies began to perform worse than no suspect ones though, with market shares of 58.6% versus 57.1%. Finally, in period t + 2, suspect firms suffered much worse performance than no suspect ones: 61% of suspect companies lost market share, but only 57% of no suspect companies did so.

[Insert Table 14 around here]

To detail the evolution of market share in subsequent years, I distinguished several groups. First, I compared the evolution of market share for companies that increased the number of licensing out contracts and achieved analysts' forecasts in previous year (*INC_NOPRESSURE = 1*) with the rest of the sample. As Table 15 shows, the percentage of observations with decreased market share grew over the three-year period (44.44% to 52.87%), whereas this trend remained quite stable (58%) for the rest of the sample. Second, I compared the evolution of the market share of companies that had not increased their number of licensing out contracts and still achieved analysts' forecasts *(NOINC_NOPRESSURE = 1*) with the rest of the sample. In Table 16, the percentage of observations with decreased market share in the focal group was stable during the three-year period (58%), but it increased slightly (55.28% to 57.29%) among the rest of the sample. Third, I compared the market share evolution for companies that had not increased their number of licensing out contracts and also did not achieve the analysts' forecasts (*NOINC_PRESSURE = 1*) with the rest of the sample. In Table 17, the percentage of observations in the group with lower market share in the three-year period fell (60.91% to 57.62%), whereas the trend was slightly increasing for the rest of the sample (54.86% to 57.79%). Fourth, to analyze if the decreasing trend in market share stemmed from financial problems, not the increase of licensing out contracts, I compared the evolution of market shares for companies that were not and those that were able to achieve analysts' forecasts. Table 18 shows that the percentage of observations with decreased market share was stable and similar for both groups (57% for companies that met analysts' forecast and 58% for the ones that did not).

From these comparisons, I can extract several conclusions. Companies with more licensing out contracts, compared with the previous year, suffer a decreasing market share trend in the subsequent two years, independent of whether their decision was made under pressure or not. This finding reflects the conventional wisdom that additional competition in the product market always can pose a threat (Fosfuri, 2006). However, this reduction in the market share does not necessarily mean that managers failed to make an efficient decision; it could be compensated for by revenue effects. Furthermore, the percentage of observations with decreased market share is greater (8% over three years) for companies that license out technology and still could not achieve analysts' forecasts than for companies that reached their earnings threshold. In line with H2, companies that increased their number of licensing out agreements under pressure experienced a greater reduction in their market share in the following years compared with companies that did not. The decrease of market share was independent of companies' previous financial situation though; it was unrelated to their meeting or not meeting analysts' forecasts. Thus I can eliminate the potential argument that the decrease in the market share is a consequence of the company's existing financial situation, rather than a negative consequence of licensing out. Figure 1 presents the main results regarding the evolution of market share over two subsequent years.

[Insert Figure 1 around here]

1.6. Summary, Discussion and Conclusion

The main objective of this study was to shed light on the relationship between the company financial's situation and its licensing strategy. In recent years, financial analysts have changed the way managers run their businesses. The consequences of failing to meet analysts' expectations have been so severe that managers increasingly focus on the short term, with greater creativity, such that they employ real activities to inflate current earnings, even if those activities come at the expense of long-term firm performance (Aaker, 1991; Bartov, 1993; Herrmann et al., 2003; Moorman & Spencer, 2008; Roychowdhury, 2006). As its main contribution, this article proposes that licensing out technology is one such creative, real activity. On the one hand, licensing out technology increases current benefits for companies by enhancing their licensing revenues (net of transaction costs); on the other hand, these companies could suffer from reduced market share or price margins, because they increase competition in the product market. By definition myopic managers emphasize the short term (revenue effect) rather than the long term (dissipation effect), so I predicted that managers under pressure to beat analysts' forecasts would license out their technology, overestimating the revenue effect. Stein (1989) argues that for managers interested in inflating short-term earnings, the easiest method is to reduce intangible asset expenditures, which are not separately recorded in balance sheets and do not relate directly to production. Licensing out technology satisfies these conditions too. Companies are not obligated to record licensing revenues separately, nor do they affect production in the short term. Licensing out intellectual property thus could provide managers with opportunities to inflate current earnings and take advantage of them for some period. But companies that engage in such practices eventually will face negative consequences.

To begin my study, I predicted that managers would be more likely to increase the number of licensing out contracts when they failed to attain analysts' forecasts in the previous year and that companies that did so also would face greater market share reductions in subsequent years than companies that did not. The tests of these two hypotheses relied on a panel of 107 U.S. companies over a twelve-year period (1,281 observations). My results confirm the hypotheses and also align with previous findings that show that managers decrease R&D expenditures when they suspect that they will not be able to achieve earnings thresholds in the next period (Bushee, 1998).

This study contributes to innovation literature by revealing that pressure to achieve analysts' forecasts is a potential determinant of licensing out technology; it also offers the first empirical test of the negative long-term consequences of licensing out (dissipation effect). Furthermore, this research contributes to myopic management theory by showing that licensing out technology constitutes a real activity that increases current earnings, at the expense of market share in subsequent years. Moreover, this activity takes place over a different temporal horizon. Previous researchers have focused on managerial strategies adopted in the period previous to negative earnings surprises; my investigation suggests that managers also adopt strategies that do not have immediate effects.

Several limitations of this study also emerge. With regard to the proxy for earnings pressure, based on whether companies failed to meet analysts' forecasts in the previous year, I acknowledge that it is not very precise. An ideal measure would reveal the exact moment managers realize that they will not meet analysts' forecasts, which is when they start deciding whether and how to inflate current earnings. In addition, firms that miss analysts' forecast might have been manipulating their results and dealing with financial difficulties for some time. It is thus impossible to determine exactly when companies decide to behave myopically and differentiate their real from their inflated earnings. In addition, in terms of the licensing data, I suspect that most licensing contracts relate to a patent (i.e., patent protection encourages licensing), but I cannot confirm this prediction; the agreements also might entail know-how, copyrights, or trade secrets. Furthermore, I noted any increase in the number of licensing out agreements, without specific information about each contract. Suspect companies were those that missed analysts' forecasts in the previous year and also increased their number of licensing contracts, but I could not confirm that the contracts related to a core technology, involved direct competitors, or featured parties operating in the same geographical area, for example. The test of H2 also included some imprecision: The results reflect a comparison of market share evolutions over a three-year period. The lack of significant results in the regression might stem from a couple of causes. First, the companies in the sample are large and diversified, and even though I identified the main sector in which each company operated (three-digit SIC code), I could not specify the exact sector in which the technology was applied, which makes it difficult to capture the dissipation effect. Second, I lacked information about the stage of the licensed technology when the company licensed it. The dissipation effect thus might arise in the next two years, or a longer period might be required. Finally, the results cannot generalize to all companies without further confirmation. Licensing out is not a common practice in all industries. Instead, the companies in this sample all (1) have intellectual assets that they can trade in markets for technology, (2) belong to industries in which licensing agreements are relatively common, (3) operate in the most developed environment (U.S.) for markets for technology, and (4) operate in a country where analysts' forecasts impose great pressure. The results cannot apply to companies that do not match these descriptions.

Further research could add to the data presented here regarding the economic conditions of licensing contracts. For example, myopic management might be measured by the fixed fee and royalties. I expect that firms engaged in myopic management establish greater fixed fees and lower royalties than optimal, to borrow earnings from the future. It also would be interesting to identify specific subsectors in which technology gets applied or the technological proximity between companies. Such an analysis could reveal precautions that managers might take to limit the dissipation extent. Companies that confront earnings pressure likely license out technology to other companies operating in the same subsector or that are technologically similar. Another extension might identify the investors of each company. Institutional investors (e.g., banks, insurance companies, pension funds) act as traders more than owners and are very sensitive to negative news. I thus expect a stronger propensity to license out technology when the investors are institutional investors. Finally, an interesting direction for further research is the application of grant-back clauses in licensing contracts, which require licensees to disclose and transfer all improvements in the licensed technology back to the licensor. These provisions limit the dissipation effect and should motivate companies to license out technology, but licensees tend to try to avoid them. Because companies that face pressure to meet earnings benchmarks need to conclude negotiations quickly, they might not insist on grant-back clauses.

This article also offers practical insights for companies. First, managers need to learn about the potential long-term consequences of licensing, so that they can analyze their licensing decision carefully and with consideration of the net harms and benefits. Second, managerial compensation plans should encourage managers to undertake projects that maximize discounted future profits, rather than immediate results. Third, a centralized licensing structure might be helpful; companies with an independent licensing department, with incentives that differ from those motivating managers, can prevent managers from simply licensing out technology to benefit from inflated current earnings. Fourth, for society in general, it would be beneficial to mitigate the negative consequences of imposing earnings pressures on managers. This pressure prevents managers from focusing on long-term strategies, such that it puts firms' survival at risk and thus may limit the level of productivity in society as a whole.

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1.8. Tables

Table 1. Descriptive Statistics and Correlations (variables reported as levels)

	MEAN	SD	MAX	MIN	1	2	3	4	5	6	7
1.LICOUT	0.502	1.173	13	0	1.000						
2.EARNINGS_PRESSURE	-0.112	0.857	4.820	-13.700	0.005	1					
3.RDINT	45.691	70.457	659.468	0.004	-0.099	-0.0111	1				
4.CL	4,516.180	8,721.251	141,579	12.751	0.173	0.0223	-0.232	1			
5.GO	5.957	45.140	1,575	-118.636	0.148	0.0014	-0.0197	-0.013	1		
6.LOGMV	9.235	1.641	13.139	1.282	0.148	0.1517	-0.1175	0.5355	0.0142	1	
7.GDPUSA	155.319	5.467	163	145	-0.022	-0.0288	0.0246	-0.0818	0.0051	0.037	1

Table 2. Licensing Out Agreements by year

Number per year	Freq.	Percent	Cum.
0	945	73.77	73.77
1	194	15.14	88.91
2	68	5.31	94.22
3	35	2.73	96.96
4	21	1.64	98.59
5	8	0.62	99.22
6	4	0.31	99.53
7	1	0.08	99.61
9	2	0.16	99.77
10	1	0.08	99.84
12	1	0.08	99.92
13	1	0.08	100

Table 3. Licensing Agreements by SIC-2

SIC2	Definition	Freq.	Percent	Cum.
36	*Electronic & Other Electrical Equipment*	286	22.33	66.28
35	*Machinery*	251	19.59	43.95
28	*Chemical & Allied Products*	180	14.05	19.67
37	*Transportation Equipment*	132	10.3	76.58
38	*Instruments & Related Products*	132	10.3	86.89
73	*Business Services*	84	6.56	100
39	*Miscellaneous Manufacturing Industries*	48	3.75	90.63
25	*Furniture & Fixtures*	24	1.87	3.75
26	*Paper & Allied Products*	24	1.87	5.62
30	*Rubber & Miscellaneous Plastic Products*	24	1.87	22.48
67	*Holding & Other Investments Offices*	24	1.87	93.44
1	*Agriculture*	12	0.94	0.94
24	*Lumber & Wood Products*	12	0.94	1.87
29	*Petroleum & Coal Products*	12	0.94	20.61
32	*Stone, Clay & Glass Products*	12	0.94	23.42
33	*Primary Metal Industries*	12	0.94	24.36
48	*Communications*	12	0.94	91.57

Table 4. Earning Pressure Distribution

	Freq.	Percent	Cum.
Positive	716	55.89	55.89
Negative	565	44.11	100
Total	1,281	100	

Table 5. Earnings Pressure Description (Variable Reported as level)

	Percentiles	Smallest		
1%	-3.43	-13.7		
5%	-0.97	-11.59		
10%	-0.51	-7.17	Obs	1,281
25%	-0.14	-6.78		
50%	0.01		Mean	-0.1121
		Largest	Std. Dev.	0.86
75%	0.08	3.05		
90%	0.27	3.35	Variance	0.73
95%	0.47	4.15	Skewness	-6.7
99%	1.51	4.82	Kurtosis	89.77

Tabla 6. Sample divided in 4 categories

	EARNINGS_PRESSURE	
	NO	*YES*
LICOUTt+1-LICOUTt<0	449 (76.90%)	417 (70.70%)
LICOUTt+1-LICOUTt>0	135 (23.10%)	173 (29.30%)

Table 7. Logit Regression. DV: Increase Licensing Out

Variables	Model 1	Model 2
Earnings Pressure		0.390**
		(0.144)
Increase Accumulated Patents Granted	0.217	0.182
	(0.139)	(0.144)
Increase Current Liabilities	0.316	0.364*
	(0.168)	(0.171)
Increase Growth Opportunities	0.256	0.320*
	(0.155)	(0.161)
Increase GDP USA	0.960***	0.846***
	(0.126)	(0.130)
Logarithm Market Value	0.146**	0.142*
	(0.0550)	(0.0588)
Year Trend	0.180***	0.193***
	(0.0203)	(0.0245)
Sector Dummies	0.112	0.161
	YES	YES
Constant	-4.256***	-4.477***
	(0.586)	(0.688)
Number of observations	1161	1057
Pseudo R2	0.117	0.128

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Marginal Effects after Logit Regression. DV: Increase Licensing Out.

Variables	Model 1	Model 2
Earnings Pressure		0.06909**
		(0.02702)
Increase Accumulated Patents Granted	0.0376402	0.0319858
	(0.02512)	(0.02637)
Increase Current Liabilities	0.054218*	0.0629662*
	(0.02599)	(0.02721)
Increase Growth Opportunities	0.0449454	0.0568265*
	(0.02582)	(0.02741)
Increase GDP USA	0.1752558***	0.1586043***
	(0.02747)	(0.02983)
Logarithm Market Value	0.0256247**	0.0252452*
	(0.00785)	(0.00839)
Year Trend	0.0316691***	0.341348***
	(0.00373)	(0.00445)
Sector Dummies	YES	YES

Marginal effects; Standard errors in parentheses(d) for discrete change of dummy variable from 0 to 1; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9. Conditional Logit. DV: Increase Licensing Out Contracts

Variables	Model 1	Model 2
Earnings Pressure		0.427**
		(0.169)
Increase Accumulated Patents Granted	0.356*	0.336*
	(0.159)	(0.167)
Increase Current Liabilities	0.419*	0.417*
	(0.164)	(0.171)
Increase Growth Opportunities	0.228	0.295
	(0.158)	(0.166)
Increase GDP USA	0.935***	0.832***
	(0.151)	(0.158)
Logarithm Market Value	0.0837	0.111
	(0.122)	(0.133)
Year Trend	0.182***	0.194***
	(0.0221)	(0.0263)
Sector Dummies	YES	YES
Number of observations	920	920
Pseudo R2	0.148	0.167

Standard errors in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10. Ordinary Least Squares Model. DV: Magnitude of the change in the number of licensing out contracts. IVs all as magnitude of the change.

Variables	Model 1	Model 2
Earnings Pressure		0.173**
		(0.0869)
Decrease Accumulated Patents Granted	0.000486	0.000667
	(0.000305)	(0.000401)
Decrease Current Liabilities	-0.0000419	-0.0000465
	(0.0000227)	(0.0000251)
Decrease Growth Opportunities	0.00192***	0.00197**
	(0.000582)	(0.000598)
Decrease GDP USA	0.00749	0.00186
	(0.0146)	(0.0162)
Year Trend	-0.0227	-0.0139
	(0.0130)	(0.0151)
Sector Dummies	YES	YES
Constant	0.161	0.0181
	(0.115)	(0.149)
Number of observations	1139	1037
R2	0.019	0.023

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11. Logit Model. DV: Decrease R&D Intensity.

Variables	Model 1	Model 2
Earnings Pressure (Year t)		0.256*
		(0.127)
Increase Current Liabilities	-0.00618	0.0242
	(0.126)	(0.127)
Increase Growth Opportunities	0.0186	0.00531
	(0.116)	(0.118)
Increase GDP USA	0.0880	0.104
	(0.116)	(0.118)
Logarithm Market Value	0.00321	0.0139
	(0.0405)	(0.0401)
Year Trend	-0.0754***	-0.0679***
	(0.0152)	(0.0155)
Sector Dummies	YES	YES
Constant	0.0823	-0.217
	(0.408)	(0.409)
Number of observations	1170	1170
Pseudo R2	0.015	0.018

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12. Marginal Effects after Logit. DV: Decrease R&D Intensity

Variables	Model 1	Model 2
Earnings Pressure (Year t)		0.0636*
		(0.0313)
Increase Current Liabilities	-0.00154	0.00600
	(0.0312)	(0.0315)
Increase Growth Opportunities	0.00461	0.00132
	(0.0288)	(0.0292)
Increase GDP USA	0.0219	0.0258
	(0.0287)	(0.0293)
Logarithm Market Value	0.000797	0.00345
	(0.0191)	(0.00995)
Year Trend	-0.0187***	-0.0169***
	(0.00379)	(0.00384)
Sector Dummies	YES	YES
Number of observations	1170	1170
Pseudo R2	0.015	0.018

Marginal effects; Standard errors in parentheses(d) for discrete change of dummy variable from 0 to 1; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13. Statistics Descriptive of Subsamples: Suspect vs Non Suspect companies

VARIABLE	SUSPECT					NO_SUSPECT				
	MEAN	SD	# OBS	MIN	MAX	MEAN	SD	# OBS	MIN	MAX
EMPLOYEES	56041.02	73996.86	171	45	399409	45485.72	67130.58	1092	9	399409
SALES	92679.83	205365.1	173	1017.907	950799	80739.98	192962.1	1108	69.4631	998093
RD	250599.9	290515.8	167	1050	997000	218641.6	228681.7	1074	69	991873
PATENTGRATED	244.6163	440.0592	172	0	2862	182.041	371.9258	1097	0	3983
ACCPATENTSGRANTED	444.9387	790.1536	173	10.2	5437.5	320.5235	654.973	1108	0	6944.4
LICENSINGOUT	0.4566474	0.917925	173	0	5	0.5090253	1.208562	1108	0	13
BOOKVALUE	10835.31	7466.867	173	-7821.114	117293.8	21261.56	15054.46	1106	-17311.02	121762.4
MARKETVALUE	40008.41	33445	173	11.45874	386402.1	71056.97	65654.3	1106	3.6048	508326.2
EBIT	98789.59	283688.6	173	-702000	988700	166510.8	281004	1108	-968000	998600
TOTALASSETS	40761.63	22526.48	173	183.256	795337	115206.4	61067.82	1108	96.074	797769
NETINCOME	1807.696	1255.43	173	-2236.58	22208	4025.233	4201.851	1108	-56121.9	45220
RETURNASSETS	0.8260289	3.464426	173	-100.922	24.348	14.57381	21.66249	1108	-458.31	48.153
RETURNSEQUITY	2.76409	-10.33611	167	-278.745	62.735	38.89527	489.2418	1082	-15631.31	327.397
RETURNINVESTMENT	2.544982	21.37836	170	-135.902	48.725	5.520043	35.09971	1103	-523.559	93.117
COMMONEQUITY	11035.65	7457.113	173	-7820	117291	21222.25	15039.12	1108	-17311	121762
CASHOPERATIONS	4177.839	2669.936	144	-1015	45967	7663.997	6155.318	948	-3991	59725
LONGTERMDEBT	10532.07	4401.127	173	0	377138	42951.38	18722.92	1107	0	330067
CURRENTLIABILITIES	5863.799	9307.219	165	14.636	52061	4310.485	8614.329	1081	12.751	121579
SHORTERMDEBT	4881.717	23832.19	173	0	195101	2384.225	14061.83	1108	0	193695

Table 14. Percentage of Observations that Decrease the Market Share in the next two years: Suspect vs No Suspect companies.

	NO_SUSPECT	*SUSPECT*
	INC_PRESSURE=0	*INC_PRESSURE=1*
T	57.58%	52.02%
T+1	57.10%	58.66%
T+2	57.37%	61.22%

Table 15. Percentage of Observations that Decrease the Market Share in the next two years: Increase Licensing Out + No Earnings Pressure vs Rest of Observations

	INC_NOPRESSURE=0	*INC_NOPRESSURE=1*
T	58.29%	44.44%
T+1	57.85%	50.52%
T+2	58.16%	52.87%

Table 16. Percentage of Observations that Decrease the Market Share in the next two years: No Increase Licensing Out + No Earnings Pressure vs Rest of Observations

	NOINC_NOPRESSURE=0	*NOINC_NOPRESSURE=1*
T	55.28%	59.68%
T+1	56.27%	58.79%
T+2	57.29%	58.50%

Table 17. Percentage of Observations that Decrease the Market Share in the next two years:

No Increase Licensing Out + Earnings Pressure vs Rest of Observations

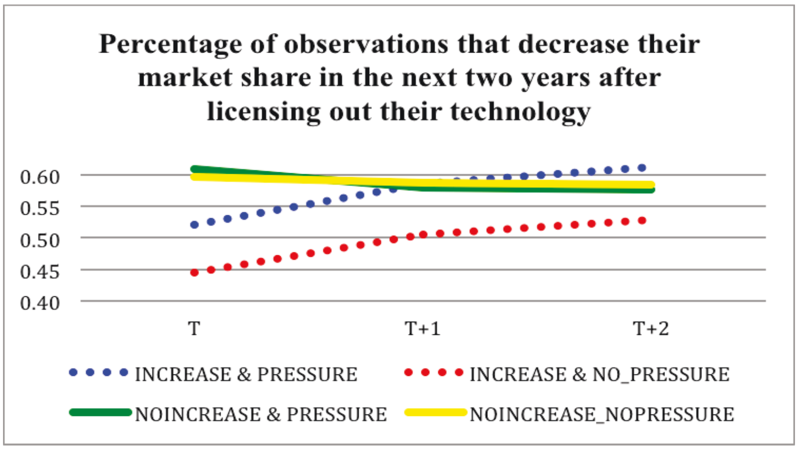
	NOINC_PRESSURE=0	*NOINC_PRESSURE=1*
T	54.86%	60.91%
T+1	56.80%	58.03%
T+2	57.79%	57.62%

Table 18. Percentage of Observations that Decrease the Market Share in the next two years:

No Earning Pressure vs Earnings Pressure

	NO_EARNINGSPRESSURE	*EARNINGSPRESSURE*
T	56.16%	58.30%
T+1	57.32%	58.15%
T+2	57.47%	58.35%

Figure 1. Percentage of observations that decrease their market share after licensing out technology.



CHAPTER 2 - Understanding the Rent Dissipation Effect in Technology Licensing Contracts.

Co-authored with Solon Moreira (CBS)

2.1. Introduction

Over the last years it has been observed substantial changes in the way firms organize their activities related to the production of new technologies (Cassiman & Veugelers, 2006). Given the strong competition in the product market, the shorter product life cycles and the increase in the use of information and communication technologies firms are continuously adopting business models that allow for more strategic flexibility (Chesbrough, 2003). Accordingly, firms rely on networks, new entrants and technology based organizations in order to generate and sustain competitive advantages (Arora & Ceccagnoli, 2011). As licensing is a less integrated alternative and the most direct way to acquire technologies developed by other companies (Fosfuri, 2006), these agreements have dramatically increased in importance and in volume over the last decades (Anand & Khanna, 2000a; Hagedoorn, 2002; Somaya, Kim, & Vonortas, 2011). Accordingly, in several industries the use of royalty payments and licensing fees have become an important mechanism for firms to profit from their investments in innovation (Arora & Gambardella, 2010).

Surveys conducted by Gambardella, Giuri, & Luzzi (2007) and Zuniga & Guellec (2009) show that among the main motivations for companies to license-out technologies is the revenue that it generates. That is, the present value of the fixed fee and/or the royalties that the licensee has to pay to the licensor (Arora & Fosfuri, 2003). Actually, in several industries it is common to observe, even large established companies, actively engaging in licensing to generate revenues (Shepard, 1987). Some notable example of firms profiting from licensing can be found in the chemical industry, computer industry and semiconductors (Arora & Fosfuri, 2003). While the generation of revenues is an important incentive for firms to license-out, granting other firms access to relevant technologies can also produce negative implications for the licensor competitiveness (Choi, 2002). Indeed, as a consequence of licensing out a technology licensors may also experience a reduction in their market-share or price cost margin as a result of the additional competition in the product market (Fosfuri, 2006). This reduction in the licensor's market-share caused by increased competition has been named rent dissipation effect. While several studies have examined questions related to the revenue generated from technology licensing (e.g., Choi, 2002; Sakakibara, 2010; Wang, 1998), empirical research focused at explaining the rent dissipation effect is still scarce.

The central role that the rent dissipation effect plays in licensing contracts is evident in comments from the managing director of an intellectual property consulting company called Intercap: *'On one hand, you don't want to abandon your patents' ability to exclude competitors from your market. But, on the other hand, you could be talking about hundreds of millions of dollars in new revenue from strategic licensing'* (Rivette & Kline, 2000). In this regard, firms' decisions to license a technology has been shown to be grounded on the interplay between the revenues generated by the licensing deal and the negative effects resulting from additional competition in the downstream product market (Fosfuri, 2006). Despite this potential negative effect, prior studies have indicated that not only firms lacking the necessary resources to generate commercial value out of their innovations, but also large established ones use licensing as an strategic alternative to profit from investment in inventive activities (Arora & Fosfuri, 2003).

In one of the few studies examining the rent dissipation effect, Arora & Fosfuri (2003) develop a model in which firms with downstream assets decide if a technology will be licensed based on the comparison between the rent dissipation caused by a new competitor (the licensee) and the revenues generated from the licensing deal. Arora & Fosfuri findings suggest that firms selling their technologies through licensing can increase their share of industry profits while imposing negative externalities upon other incumbents operating in the same product market. In a similar direction, Fosfuri (2006) offers empirical evidence of the rent dissipation effect by focusing on the supply side of markets for technology to demonstrate how the competition among multiple technology holders triggers a more aggressive licensing behavior. In a more recent study Gambardella & Giarratana (2012) relaxes some of the assumptions found in Arora & Fosfuri's model to show that high heterogeneity among players within the same industry reduces the extent to which licensors will experience rent dissipation. Altogether, this stream of literature has consistently indicated that the firms' decision to license-out their technologies is directly related to competitive implications experienced at the product market (Choi, 2002; Katz & Shapiro, 1985). However, although those studies have comprehensively increased our understanding about the functioning of markets for technology, to the best of our knowledge no previous study has yet developed empirical evidence directly linking licensing-out and dissipation effect.

In this paper, we develop and empirically test a model that explains the dissipation effect experienced by licensors using a perspective that incorporates three important dimensions of the markets for technology: 1) if the licensors possess downstream assets, 2) licensee size and 3) technological overlap between the licensor and the licensee. The main contribution of this paper lies on the development of an empirically testable model concerning one of the central assumptions of markets for technology (the dissipation effect), which hasn't been tested against empirical data. Furthermore, we integrate the insights from previous studies in a novel way to build and test our hypotheses. First, we drawn on Arora & Fosfuri' s (2003) proposition that the dissipation effect tends to be higher for firms with downstream assets in the product market. Second, we also consider the licensee's perspective (Ceccagnoli & Hicks, 2012; Ceccagnoli & Jiang, 2012; Laursen, Leone, & Torrisi, 2010) to account for the fact that the licensee's capacity to commercially exploit the licensed technology plays an important moderating role between technology licensing and the rent dissipation effect. In this regard, Arora & Gambardella (2010) call attention to the fact that the demand-side of markets for technology has received less attention in licensing literature. Therefore, in our model we incorporate the view that licensees differ in their capacity to commercially exploit the licensed technology, which naturally impacts in the licensor's rent dissipation. Finally, our model also considers the effect of the technological overlap between the licensor and the licensee. Previous research has shown that the licensing decision is subject to how technologically close are the patent portfolios of both companies (Arora & Fosfuri, 2003; Laursen et al., 2010). Hence, we apply this idea of technological proximity to propose that the dissipation effect resulting from licensing out core technologies will be weaker in a context where the technological overlap between the parties is low. In testing those three propositions we are not supposing that firms take inefficient decisions that lead to rent dissipation. On the contrary, we build on Arora & Fosfuri's (2003) proposition that the licensing decision is based on the balance between dissipation and revenue effects[18].

We test our hypotheses using a sample of 163 licensors involved in licensing contracts within the US pharmaceutical industry during the period of 1984 – 2004. We use supplemental data from COMPUSTAT and the United States Patent and Trademark Office - USPTO to obtain specific characteristics of licensors, licensees and the licensed technology. A major strength of our dataset regards the fine-grained information that we could obtain from the licensing contracts which allowed us to combine three different data sources to estimate the effect that technology licensing has on subsequent changes on the licensor's share in the product market. We used a fixed effect model as the econometric technique to model the relationship between the dependent and independent variables. The results offered robust support to most of our hypotheses.

The paper is organized as follows. First, we present theoretical arguments and hypotheses. Second, we describe the databases used in this study and how the dependent and independent variables were calculated, following by the econometric technique used to estimate our models. Finally, we present the results and conclusion.

[18] Given the scarcity of data that allows connecting firms' overall revenues to a specific licensing deal, we decided to mainly focus on the dissipation effect and just supplement the main analysis with information regarding the remuneration structure of the licensing contracts as a proxy for the revenue effect.

2.2. Theory and Hypotheses

2.2.1. Licensing

Licensing contracts are agreements between companies through which the owner of the technology (licensor) allows to other company (licensee) to make, sell and use a technology without transferring its ownership in exchange of an economic compensation (Granstrand, 1999). Over the last years licensing agreements have experienced an unprecedented growth (Kamiyama, Sheehan, & Martínez, 2006; Zuniga & Guellec, 2009) and, nowadays, it represents one of the most important options available to transfer technology (Anand & Khanna, 2000b; Arora & Fosfuri, 2003). In fact, given its significance, the U.S. Department of Justice has defined markets for technology as *"markets that consist of intellectual property that is licensed and its close substitutes"* (U.S. Department of Justice, 1995). Although it is also possible for firms to enter into licensing agreements concerning the joint development of licensed technologies, this type of contract is usually characterized as an arm's length contractual deal with low level of vertical integration (Ceccagnoli & Jiang, 2013; Grindley & Teece, 1997). Indeed, in most licensing deals signed between firms the traded technology is already developed and commercially proven[19] (Atuahene-Gima, 1993; Leone & Reichstein, 2012).

In principle, licensing offers strategic advantages for licensors and licensees. On the demand side, licensees can benefit from acquiring externally developed and proven technologies (Atuahene-Gima, 1993), from reducing product development risks and costs (Lowe & Taylor, 1999) from adopting more diversified and less integrated R&D structures (Chesbrough, 2003). On the supply side, licensors increase the possibilities to recover the investments and generate revenue from innovations (Arora & Ceccagnoli, 2006; Teece, 1986), achieve rapid market penetration (Lei & Slocum Jr, 1991) and facilitate the development of complementary products (Shepard, 1987). However, involving in licensing as a mean to commercialize technologies may also impose risks. On the demand side, licensees could become highly dependent on the

[19] Jensen & Thursby (2001) identified that in most of the cases the technologies commercialized by universities are at early stages, requiring substantial further work to reach a stage that would allow it to be commercially exploited by firms. However, we restrict our analysis to licensing contracts between firms.

licensors for the maintenance of the technology (Walter, 2012) and suffer with limited comprehension on how to further develop the licensed technology (Leone & Reichstein, 2012) . On the supply side, in addition to the rent dissipation effect, licensors could lose the control of the licensed technology and become heavily dependent on the licensee to generate revenue (Arora & Fosfuri, 2003; Fosfuri, 2006).

As a consequence, the licensing decision is far from being straightforward for firms. Arora & Fosfuri (2003) focus on the licensors' point of view to propose a framework predicting the firm's rate of licensing. In their model, the licensing decision is the result of the interplay between two opposite effects: revenue effect versus dissipation effect. The revenue effect refers to the benefits that licensing generates, which consists of the present value of the payments that the licensee will made to the licensor, net of transaction costs. Accordingly, the pecuniary benefits that are connected to licensing contracts are one of the main factors that firms take into account in order to decide to license-out a specific technology (Kulatilaka & Lin, 2006). On the other hand, the dissipation effect refers to the potential reduction in the licensor's benefits, measured as a lower market share or a lower price cost margin, as a consequence of additional competition in the final product market. Even though previous research has proposed several strategies to limit the latter effect (Cohen, Nelson, & Walsh, 2000; Granstrand, Patel, & Pavitt, 1997), an additional competitor may always be considered a potential threat for the licensor (Fosfuri, 2006). Therefore, firms seek to balance the revenue effect, which is a short-term effect, against the dissipation effect, which can influence firm performance in the long run (Arora & Fosfuri, 2003; Fosfuri, 2006).

Beyond the monetary compensation that licensing generates, firms may also choose not to exploit a technology in-house as a consequence of several other factors. First, in order to commercialize a technology independently firms must develop specific assets and capabilities such as commercialization channels, sales workforce and infrastructure to service clients (Gans & Stern, 2003). When considering the expected return from those investments, licensing may appear as a more interesting alternative as other firms in the market may already possess the necessary assets. Second, established firms launching a new product run the risk of cannibalizing their own market and erode their competitive position (Hill & Rothaermel, 2003). Third, licensing creates possibilities for cooperation between the licensor and the licensee, which mitigates risks inherent to investments that are necessary to make a technology into a marketable product (Gans & Stern, 2003, 2010). In line with the third point, Choi (2002) proposed a distinction between competition that a firm faces in the current product market (Kamien, 1992; Katz & Shapiro, 1985) and the innovation market (Choi, 2002; Gans & Stern, 2010). While the first regards the competition that licensing triggers within the product markets that the licensor operates at the moment of the licensing deal, the second is related to a more dynamic process through which competition is increased in the long run as a consequence of technological developments in the licensed technology.

Despite the fact that previous studies have pointed out certain contingencies and characteristics related to the licensing process that accentuate the dissipation effect (Arora & Ceccagnoli, 2011; Cohen et al., 2000; Granstrand et al., 1997; Helpman, 1998), no empirical evidence has been produced indicating the direct relationship between rent dissipation and technology licensing. Based on previous research we focus on three main factors regarding technology and firm specificities that could influence the dissipation effect experienced by the licensor. First, we consider that licensors are more likely to be susceptible to the dissipation effect in the cases that the licensed technology constitutes a core, instead of peripheral, technology. We expect that the degree to which a technology is connected to the licensors' main technological activities is an indication of the possession of the downstream assets. Furthermore, core technologies are mostly observed to be superior to peripheral ones in terms of production costs, market value and potential to be further refined (Choi, 2002). Second, licensors are more susceptible to the dissipation effect if the licensee is increasing on size. Large companies are more able to appropriate value from inward licensing (Walter, 2012). Finally, we also expect that the magnitude of the dissipation effect to be affected by the level of technological overlap between the licensor and the licensee. In this case, it is expected that lower technological overlap reduces the dissipation effect resulting from licensing out core technologies.

2.2.2. Licensing Out Core Technologies

The technological portfolio of a firm is formed by core and non-core technologies that are related to the markets in which the firm operates (Granstrand et al., 1997). Core technologies represent a firm's main source of competitive advantage as they constitute the outcome of a path dependent process regarding the accumulations of unique expertise (Prahalad & Hamel, 1993). In general, core technologies are distinct given their potential access to a wide variety of markets, significant contribution to the perceived customer benefits of the end product and the difficulty for competitors to imitate it (Choi, 2002; Prahalad & Hamel, 1993). Given the competitive implications that licensing-out core technologies may bring to the licensor, the licensing literature does not frequently considers it as an alternative for firms. However, if the licensor is able to either avoid creating direct competitors (Fosfuri, 2006; Leone & Reichstein, 2012) or receiving monetary remuneration that is compatible with the potential rent dissipation, core technologies will also be licensed (Choi, 2002).

In fact, considering both sides of the markets for technologies, deals involving core-technologies are more likely to take place comparatively to deals regarding peripheral technologies. Indeed, core-technologies are more valuable for licensees as they have more potential to be developed into a future generation of related products at the same time that allows the acquiring firm to produce more revenue in the short term (Choi, 2002). Therefore, considering this perspective, if the licensor can use licensing payment (e.g., fixed fees and royalty rates) to appropriate a necessary amount sufficiently large to overcome the decrease in the profit due to future competition, then deals exchanging core-technologies are likely to happen. Furthermore, even if the uncertainty related to the licensed technology is as high as to prevent all contingencies to be fully foreseen in a licensing contract, the use of royalty-based payment is an option to ensure that the core-technologies (valuable) will be traded (Gallini & Wright, 1990; Gans, Hsu, & Stern, 2008).

There are also other factors, in addition to revenue generation, that may affect firm decision to license core-technologies. First, by engaging into licensing deals firms may access the licensee's assets and capabilities that can be useful in further developing the licensed technology (Leone & Reichstein, 2012). The complexity related to the development of certain technologies can move firms to enter into R&D partnerships (in form on licensing contracts) in order to mitigate risks and increase the chances that a technology will continue to be developed (Duysters & Hagedoorn, 2000). This is particular true for firms that are strongly centered around a small group of core capabilities in a particular technological field, as those firms are more likely to develop rigidities they are also more susceptible to fail to keep up with environmental changes (Song, Almeida, & Wu, 2003). Furthermore, licensing is also an alternative for firms to implement open innovation strategies (Chesbrough, 2003). Second, it is not uncommon that the development and introduction of a new product require several complementary technologies that are not all in possession of a unique firm. Under these circumstances firms may possess in-house a technology that only has the potential to generate rents when combined with those of other firms (Fershtman & Kamien, 1992). In this case, a firm may pursuit the development of technologies which are related to its core business and agree to provide its access to other firms in exchange for the access to their technologies (Eswaran, 1994).

In spite of the different motivations that firms might have to license core-technologies, we expect that technologies which are close to the firms main business reflect the areas in which the licensor possess related downstream assets (Arora, Fosfuri, & Gambardella, 2001; Ceccagnoli & Hicks, 2012). This observation lead to the assumption that licensors will experience stronger competition originating from licensing-out a technology if it is closely related to the firm's main line of business. Therefore, to build our baseline hypothesis, we follow the argument developed by Arora & Fosfuri (2001) that licensors are more likely to experience rent dissipation in the cases in which downstream assets related to the licensed technology are possessed in-house. Our baseline hypothesis therefore states:

Hypothesis 1: *The closer a technology to the licensor's core technological activities, the stronger the dissipation effect, everything equal.*

2.2.3. Licensing Out Core Technologies and Licensee Size

The relationship between firm size and the propensity to license-out has been deeply explored by previous literature. Several studies have identified size as one the main determinants that explain licensing-out activities (Fosfuri, 2006; Gambardella et al., 2007; Kani & Motohashi, 2012), with the results indicating that as size increase the propensity to license-out decreases (Gambardella et al., 2007). In particular, previous research has found that smaller firms license-out more technologies as a consequence of the lack of legitimacy and the downstream. Therefore, in most of the cases licensing-out is the only way to appropriate rents from their investments (Arora & Fosfuri, 2003; Fosfuri, 2006). From the point of view of the licensee, size is expected not only increase the propensity to license-in, but also to explain the capacity that the acquiring firm will have to exploit the acquired technology (Walter, 2012). Indeed, as larger firms have several advantages in exploiting resources from the environment (Atuahene-Gima, 1993), many cross-firm differences in terms of their capacity to exploit licensed-in technologies comes from differential advantages related to size and R&D intensity,.

One of the key factors of the licensing process is the efficiency of the licensee in applying the newly acquired technology in the product market (Arora & Gambardella, 2010). No doubt, this efficiency is highly dependent on the licensee's capabilities, which in turn, are closely connected to firm size. Accordingly, Walter (2012) has shown a positive relationship between firm size and the propensity to license-in. Given that large firms are characterized by greater economies of scale in R&D, faster learning curves and the downstream assets needed to commercialize the final product (Cohen & Levinthal, 1990; Van Wijk, Jansen, & Lyles, 2008), they are able to capture more value from licensing-in. Although larger firms also have a number of disadvantages related to innovation such as rigidities (Dosi & Marengo, 2007) and organizational inertia (Chen & Hambrick, 1995), we expect that the effect of size on firm capacity to commercially exploit a newly acquired technology in the product market to be positive. Moreover, considering Teece's (1986) seminal work on firm capacity to profit from innovation, the successful commercialization of externally acquired technologies is conditional upon capabilities and other complementary resources, which are more likely to be present in larger firms (Walter, 2012).

Following this line of reasoning, larger firms vis-à-vis to small firms are more likely to present a substantially high amount of resources related to the commercialization and manufacturing of the licensed technologies (Teece, 1986). This conclusion naturally leads to implications on the rent dissipation effect that licensors experience when licensing-out core technologies. Considering the baseline hypothesis regarding the extent to which a technology is core to the licensor's main technological activities, we expect that as the licensee increases in size the competition within the licensor main business lines also increase. Actually, given that peripheral technologies are unlikely to cause meaningful rent dissipation for the licensor, we expect that licensee size will increase rent dissipation only when the licensing deal involves licensor's core technologies. Therefore, we expect that the dissipation effect caused by licensing-out core technologies will increase with licensee size. Our second hypothesis thus states that:

Hypothesis 2*: Everything else equal, the larger the licensee firm, the stronger the dissipation effect caused by licensing core technologies.*

2.2.4. Technological Overlap between partners

Another important dimension of the licensing process that directly affects the dissipation effect regard the extent to which the licensor and the licensee operate in the same niches within the product market (Gambardella & Giarratana, 2012). Actually, from the licensor's perspective it would be preferred to license to firms that build on a different set of technological capabilities as they would be less likely to turn into a competitor in the product space (Arora & Gambardella, 2010). Indeed, if the licensor can supply a technology to a firm with which it has low level of overlap, the effect of increasing competition observed on both technology and product markets will be substantially smaller as compared to licensing to a firm with high technological overlap. Firms operating within close technological fields are more likely to share similar resource bases (Hannan & Freeman, 1977), which increases the likelihood that they will commercially exploit the licensed technology in similar ways. As a result, high overlap puts licensor and licensee in more direct competition with each other (Gambardella & Giarratana, 2012; Walter, 2012).

Although license-out to firms with low technological overlap would be an optimal alternative from the licensor perspective, licensing deals between firms operating in different technological segments are not always possible. Indeed, markets for technology are mainly characterized by asymmetric information between the parties, by difficulties to describe and to value the technology and by the uncertainty about the validity and applicability of the traded technology (Arora & Gambardella, 2010). As a consequence, firms can reduce those problems if they belong to close a technological field (high overlap), which significantly limits the extent to which deals between firms no technological overlap happen. In this context, from the licensee point of view, it is easier to identify and understand the value of a specific technology when operating with similar technologies to the licensor (Gambardella & Giarratana, 2012). Furthermore, technologies licensed from a firm with similar technological portfolio are easier to evaluate, assimilate and apply (Arora & Gambardella, 1994; Cohen & Levinthal, 1990). On the licensor side, it is easier to scream the technological space for potential licensees that operate in the closer technological fields. In summary, high technological overlap between the parties reduce search costs and other frictions that are inherently present on the markets for technology.

Building on the arguments presented above, we claim that licensing deals are most likely to involve firms with some degree of technological overlap in their portfolio. In other words, deals are unlikely to happen between firms with absolutely no overlap as several issues ranging from to partner identification to technology transferability can prevent those deals to happen. On the other hand, firms with perfectly similar technological portfolios are unlikely to enter into licensing deals as the risk of generating competition becomes too high[20]. Those arguments lead to the idea that the technological overlap between the firms signing a licensing contract will fall in a continuous between perfect and no overlap.

Shared similarities between the licensor and the licensee in the technological space are also likely to be reflected in the product market. Accordingly, we consider the effect that low level of technological overlap has an effect on the magnitude of the dissipation effect experienced by the licensor. Therefore, we propose that companies with low technological overlap are less likely to directly compete within the same technological niche, which weakens the dissipation effect caused by licensing out core technologies. Therefore, we state:

Hypothesis 3: *Everything else equal, the lower the technological overlap between the licensor and the licensee, the weaker the dissipation effect by licensing out core technologies.*

Figure 1 provides an overview of the conceptual model proposed in this paper[21]. First, the arrow referring to hypothesis 1 indicates a positive relationship between licensor core technologies and the dissipation effect. Second, this relationship is positively moderated by the licensee size (*H2*). Finally, the lower level of technological overlap between licensor and licensee negatively moderates the relationship between the licensor's core technology and the dissipation effect (*H3*).

[*Insert Figure 1 around here*]

[20] Choi (2002) proposes that such deals could still take place if the licensee would agree to pay a high lump-sum payment and/or royalty fee to the licensor. However, if the total amount to be paid becomes too high then the licensee is unlikely to pursuit those deals.

[21] Figure 1 summarizes the conceptual model developed in this paper, but the way that the dissipation effect is operationalized in the empirical model uses the inverse interpretation for the direction of the coefficients for the main independent variables.

2.3. Data, Methodology & Variables

2.3.1. Sample Selection and Data

It is challenging to study empirically the rent dissipation effect. The availability of public data for systematic quantitative studies that allow modeling the relationship between technology licensing and rent dissipation is limited. Licensors usually do not publicly report which technologies are licensed, and the financial fillings rarely allow connecting firm revenue to a specific licensing deal. An alternative to overcome the lack of public data could be the use of interviews or questionnaires, but these methods would impose significant limitations. First, respondents may be unwilling to reveal strategic information regarding the nature of the licensed technologies as well the contractual specifications of the deal. Second, there are substantial timing effects and cross-firm heterogeneity that could also explain a reduction on the licensor's share in the product market, which are hard to be considered without the use of a longitudinal setting. To overcome those issues and test the proposed hypotheses we relied on detailed information extracted from a sample of licensing contracts that allowed linking licensing contracts to patent data and financial performance of the licensors. The sample, measures and methods are summarized below.

The research setting for this study is the U.S. pharmaceutical industry. Firms in this industry produce and commercialize drugs, chemical components and technologies. Several characteristics of the pharmaceutical industry make it a useful empirical setting for testing the relationship between technology licensing and the rent dissipation effect. First, licensing is one of the most common methods of technology transfer among pharmaceutical companies. Second, the pharmaceutical industry is characterized as technology driven and research intensive, what makes technological knowledge a critical component to develop and sustain competitive advantages (Roberts, 1999). Third, since our main analysis relies on patent data, we choose an industry in which firms routinely and systematically use patents to protect their inventions (Hagedoorn & Cloodt, 2003). Those characteristics correspond to an industry in which markets for technology are well developed and present lower frictions, which facilitates the transaction of technologies using licensing contracts. Accordingly, the fact that the pharmaceutical industry presents those specific features creates a trade-off in terms of the generalizability of results and how precise we are able to measure the variables used in the econometric analysis. However, given the scarcity of empirical evidences on this topic we believe the purposeful choice of this industry to be appropriate to shed light on important, and yet empirically unexplored, aspects of technology licensing and the rent dissipation effect.

The data used to develop the empirical analysis come from three different sources. First, as a starting point, we used the Deloitte Recap Database to obtain the licensing contracts involving U.S. pharmaceutical firms. We choose this database because it is one of the most accurate sources of information regarding partnerships in the pharmaceutical industry (Audretsch & Feldman, 2003; Schilling, 2009). Additionally, it allowed us to access the original licensing contracts from which we could extract precise information regarding the contractual and technological aspects of the licensing deals. Second, we obtained information regarding the patenting activity of licensors and licensees from the National Bureau of Economic Research (NBER) patent database. Finally, we extracted from Compustat database firm's financial information.

Considering that one of the main ideas developed in this paper regards the degree to which the licensed technology represents a core activity to licensors, we focus only on contracts in which it was possible to identify the licensed technologies in an unambiguous manner. The way to do it was to focus on licensing contracts containing a 7 digit patent number connecting a specific technology to the United States Patent and Trademark Office (USPTO). This setting allows calculating the relative importance of the licensed technology in relation to the licensor's overall activities. Although we use patent data to calculate how core a technology is, our analysis only concern the rent dissipation related to product market activity. For example, if the licensor A decides to license a specific technology to the licensee B, the effect that we are trying to capture is a consequence of licensee B commercially exploiting the licensed technology and consequently creating competitive pressures over licensor A. Additionally, we also acknowledge that the dissipation effect can also increase overtime as a consequence of learning effects experienced by the licensee and not only as a consequence of the immediate commercial exploitation of the licensed technology. However, following an innovation perspective, the time that licensees may take to assimilate, recombine and apply the licensed-in technology into something new is excessively long to be captured with the empirical setting adopted in this paper. For this reason, we only use licensing contracts that include commercialization clauses in its contractual scope, which implies that the licensee is allowed to commercialize the licensed technology without the need to further develop or incorporate it in a new product (Parr & Sullivan, 1996).

The matching process between the licensing contracts extracted from the Recap and the two other databases was done as follow. The first step was to use the licensor's name and industry described in the licensing contract to identify the corresponding observation in the Compustat database. Second, using the Compustat firm identifier (GVKEY) we also connected the licensors with the National Bureau of Economic Research (NBER) U.S. patent data file[22]. To ensure an accurate matching we checked manually each individual GVKEY match between Compustat and NBER datasets. Given that a substantially high number of licensees in our sample are non-public firms we were not able to satisfactorily match the licensee firms with Compustat, but because the patent data is less restrictive[23] we were able to connect the licensees with the NBER database. In order to drive the matching process for the licensees we relied on firm name and country. Based on licensors and licensees patent information it was possible to construct measures for the firm's technological assets using the patenting behavior prior to the licensing date. However, measures based on patent information are poor indicator for firms' technological profile in the cases that the firm is not listed as an assignee on any patent within the years prior to the licensing contract. Therefore, firms that have not filled at least one patent during the time frame used to calculate the variables were dropped from the final sample.

[22] We employed the NBER data version developed in which it is made available the GVKEY numbers linked to the assignee number of patent applicants

[23] While Compustat only includes public firms, the patent data lists all the firms that filled at least one patent between 1976-2006

After selecting the contracts that met those specifications and conducting the matching process between the three databases, we arrived to an estimation sample of 330 observations regarding 163 unique licensors and 198 unique licensees involved in licensing contracts during the period 1984-2004[24]. This number corresponds to approximately 69% of the original contracts that matched the required characteristics to be used in the empirical analysis

2.3.2. Method

To estimate the rent dissipation effect experienced by each licensor subsequently to the licensing deal, we follow the conceptual references offered by prior literature on markets for technology (Arora & Fosfuri, 2003; Arora & Gambardella, 2010; Fosfuri, 2006) and specify the dependent variable as a relative changes in the licensor market-share. Despite the fact that we are not aware of any previous attempt trying to measure the dissipation effect in this way, a number of studies have applied this variable in a similar manner for different purposes (Ferrier, Smith, & Grimm, 1999; Giroud & Mueller, 2011). One potential issue in estimating the relative changes in the licensor market-share after a licensing deal regards the fact that a firm already experiencing financial problems may also be more likely to involve in licensing deals as a way to generate short-term revenue, which would produce biased estimates due to simultaneity (Verbeek, 2000). In order to try to deal with this problem, we added the change on the licensor market-share in the year prior to the licensing date as one of the predictors, which should capture the effect of the past performance on the subsequent changes in the licensor market-share. As a robustness check, we also applied the Wooldridge (2002) test for autocorrelation in panel data and the estimators indicated no evidence of first-order autocorrelation.

The first approach we considered to test the proposed hypotheses was a fixed effects model as a way to account for substantial unobserved firm heterogeneity that commonly effect studies dealing with corporate performance measures (Coles, Lemmon, & Felix Meschke, 2012). However, in the case that the unobserved firm-specific effects are uncorrelated with the

[24] Although the NBER patent database would allow tracking firms patents until 2006, we decided to include the observations only until 2004 as a way to deal with potential truncation issues regarding the number of forward citations received by patents

regressors, the use of random effects model would be most appropriate given that it produces more efficient estimators (Greene, 2003). In the case of modeling the dissipation effect, the random effects assumption implies that unobserved characteristics of firm *i* affecting the relative changes in the licensor's market-share, such as aspects of corporate governance and firm inability to innovate, are not correlated with licensing strategy, technological overlap and licensee size. To test if the use of random effects is appropriate we applied a Hausman (1978) test to compare the coefficients and capture systematic differences between both fixed and random effects. The results indicated significant differences between the random and fixed effects estimators (chi = 69.83, $p < 0.001$), confirming the suitability of fixed effects to model the effect of technology licensing on subsequent changes on the licensor's market-share. Additionally, we also included year dummies to control for period effects, such as differences in macroeconomic conditions that could also affect firm performance. Finally, robust standard errors were used to rule out heteroskedasticity concerns (Wooldridge, 2002).

One of the main advantages of this empirical setting regards the use independent data sources to calculate the variables applied in the econometric analysis. The combination of multiple sources is a useful strategy to mitigate bias issues related to artificial variance created from a single database (Avolio, Yammarino, & Bass, 1991; Doty & Glick, 1998). Accordingly, while the dependent variable is calculated based on Compustat information, the main explanatory variables are a composition of information extracted from the Recap and NBER patent databases.

2.3.3. Variables

Dependent Variable: *Dissipation Effect*

We compute the dependent variable as a continuous change in the licensor market share in the first year after signing a licensing contract. Following a similar approach to (Ferrier et al., 1999), the first step to calculate this variable was to compute the licensor's market-share using the ratio between licensor's sales and the total sales in the licensor's industry reported on

Compustat. The industry sales were calculated based on all U.S pharmaceutical firms operating in the within the same four-digit SIC code at year *t*. Following prior research (Giroud & Mueller, 2011), we used all available Compustat firms within the same licensor's SIC code. We excluded firms for which the sales were either negative or missing. Then, our final measure is derived from the differences in the logarithm of licensor's market:

$$Dissipation\ Effect = \ln(MS_{t+1}) - \ln(MS_{t})$$

Where $\ln(MS_{t+1})$ represents the licensor's market-share in the first year after signing the license contract; and $\ln(MS_{t})$ at the same year. This measure can be interpreted as positive values representing an increase while negative values a decrease on licensors relative market-share in the year subsequently to the license agreement. The rent dissipation effect measures in this manner is consistent with the concepts proposed in the markets for technology literature, according to which licensors are likely to experience increasing competition in the product market in the period that follows the licensing deal (Arora & Fosfuri, 2003; Arora & Gambardella, 2010; Fosfuri, 2006).

Focal Independent Variables

Licensor's core Technology

The extent to which the licensed technology represents a licensor's core technological activity is calculated using the licensor's overall patenting activity in the years anteceding the licensing deal. This measure is operationalized based on the *focal index* proposed by Ziedonis (2007). One of the key underlying assumptions in the use of the focal index regards the fact that the licensors patenting activity represents a good indication of overall technological and market activities, which have been shown to be the case in the context of the pharmaceutical industry (Hoang & Rothaermel, 2010; Roberts, 1999). Accordingly, how core the licensed technology is to the licensor is then measured on basis of the patent class connected to the licensed technology and the technology classes the licensor has been active prior to the licensing date[25]. To illustrate this, if the share of the licensor's patent portfolio assigned to the same patent class as of the licensed technology is high then the technology in question is considered a core technology. This variable will be calculated as follows:

$$\textit{Licensor's core Technology} = \left[\frac{(\sum_{t-6}^{t}\sum_{j} C_i \rho_i)_c}{(\sum_{t-6}^{t}\sum_{j} C_i \rho_i)}\right]$$

In which $(\sum_{t-6}^{t}\sum_{j} C_i \rho_i)_c$ represents the citation-weighted sum of firm *i*'s patents that were applied for within five years at the time of the license agreement *t* and belong to the same primary patent class *c* as the one of the licensed patent; and $(\sum_{t-6}^{t}\sum_{j} C_i \rho_i)$ is the sum of all citation-weighted patents issued to the firm j that were applied for by date *t* following the same time window of five years. The use of weighted citations offers the possibility to capture the relative importance of each patent within the firm's portfolio (Griliches, 1990). Additionally, Hall, Jaffe, & Trajtenberg (2001) call attention to the fact that the number of citations received by any given patent is naturally right-truncated in time, since it is only possible to observe the citations received so far. Furthermore, the fact that patents differ in age results in different degrees of truncation[26]. To overcome this issue we use a multiplier factor that corrects for the truncation problem by considering differences between the patent's grant years and the technological categories.

Technological Overlap

To measure the technological overlap between licensee and licensor we also rely on the patent classes in which both firms have been active prior to the licensing contract (Jaffe, 1986;

[25] For the contracts negotiating more than one technology we calculated focal index based on the average values considering all technologies identified by a patent number
[26] 50% of citations are made to patents at least 10 years older than the citing patent, 25% to patents 20 years older or more, and 5% of citations refer to patents that are at least 50 years older than the citing one (Hall et at., 2001)

Sampson, 2007). Prior studies have indicated that patent classes can be used as a reliable indicator of specific technological fields in which the patenting firm operates (Lanjouw & Schankerman, 2004; Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007). Therefore, we use the measure proposed by (Jaffe, 1986) to capture the technological position of the licensor relatively to the licensee in terms of the technological fields in which both firms have patented. In order to construct our measure we first generated separately the technological profile of licensors and licensees by measuring the distribution of accumulated patents across different classes in the prior 5 years to the licensing contract. Similar to prior studies (e.g., Sampson, 2007) we obtained a multidimensional vector, $F_i = (F_i^1 ... F_i^S)$, according to which F_i^S represents the number of patents assigned to firm *i* in the patent class *s*. Because we are interested in investigating how low levels of technological overlap moderate the relationship between licensing and rent dissipation the variable we inverted this variable by subtracting it from 1, as follows:

$$Technological\ overlap = 1 - \frac{F_i F_j}{\sqrt{(F_i F_i)(F_j F_j)}}$$

Accordingly, this measure takes value 1 for firms which have orthogonal vectors, value 0 for firms with full overlap in their patenting activity, and a value between 0 and 1 for the cases in which there is an intermediate degree of orthogonality between licensor and licensee.

Licensee Size

Given that we could not successfully match a satisfactory number of licensee firms with the Compustat database, we relied on a patent stock measure as a proxy for licensee size. Therefore, the measure for licensee's size is based on the logarithm of the total number of patents filled by the licensee within 10 years[27] before the licensing contract. Although we recognize that this proxy has limitations, there are reasons to consider the licensee's patent stock a reliable proxy

[27] Alternatively we estimated the models also using 5 and 15 years to calculate licensee's patent stock and the results remained the same

for firm size. Examining the relationship between patent stock and number of employees for the licensor firms in our sample it is observed a significant correlation of 63% between those two variables. Furthermore, a number of previous studies have also proxied firm size using the total number of patents accumulated over time (Cantwell & Santangelo, 2000; Quintana-García & Benavides-Velasco, 2008). Still, one could argue that in certain circumstances small firms may display an extensive patenting activity as compared to large firms, but if that is the case then the size measure would lead to downwards bias (against the results we expect), given that small firms are less likely to cause more rent dissipation vis-à-vis to large ones.

Control variables

To minimize alternative explanations and isolate the effects of the explanatory variables, we controlled for several factors regarding firm, contract and technology characteristics that could also explain changes in the licensor's market-share. Regarding firm characteristics we control for size using the logarithm of the licensor's number of employees at year *t*. We control for licensor's *R&D intensity* by including the R&D expenditures divided by the firm total sales. How specialized the licensor is in terms of different technological fields may also affect the extent to which it is subject to the rent dissipation effect, in order to control for this characteristic we calculated a Herfindahl index based on the classes connected to all the patents the licensor successfully applied prior do the licensing date.

We also control for contractual specification by adding dummy variables capturing four legal aspects of the deal. First, licensing contracts that allow the licensee to sub-license the acquired technology are likely to amplify the dissipation effect experienced by the licensor, so we added a dummy variable indicating if the licensing deal regards a contract which allows *sub-licensing*. Second, licensing contracts may stipulate if the licensee is exclusive or not, we expect that the exclusivity clauses can affect the dependent variable in either way positive or negative. On one hand, if the licensee is exclusive it may be more willing to commercially exploit the licensed technology in a more aggressive way. On the other hand, the fact that the technology is restricted to a single firm could also reduce the rent dissipation. Third, we also use a dummy variable to indicate if the licensing contract includes royalty fees in its remuneration structure (Choi, 2002). Finally, we also included in the econometric analysis a dummy variable indicating if the licensing contract allows the licensee to further develop the licensed technology. We expect that licensees are more likely to require this clause to be included in the contract when the licensed technology presents a high potential to be further developed and commercially exploited, which might also affect the rent dissipation experienced by the licensor.

The final set of control variables regards specific characteristics of the licensed technology. We expect that more valuable technologies are also more likely to result in stronger rent dissipation, therefore we followed the convention in the patent literature and proxy value by the total number of forward citations received by a given technology (Trajtenberg, 1990). We control for the age of the licensed technology using the time difference between the application date of a patent and the date of the licensing deal. Finally, in order to account for heterogeneity originated from differences in the technological fields of licensed technologies we follow prior studies (Gambardella, Harhoff, & Verspagen, 2008; Jaffe, 1989; Mowery, Sampat, & Ziedonis, 2002) we grouped the patent classes into 4 main technology fields based patent classes and generated dummy variables for each of them (Hall et al., 2001).

2.4. Results

2.4.1. Descriptive Statistics

Table 1 reports the means, standard deviations and Pearson correlation coefficients of the variables used in the fixed effects model. The correlation does not warrant further examination with respect to multicollinearity. Additionally, the maximum variance inflation factor (VIF) associated with any of the independent variables was 1.66 (mean VIF = 1.39), which is well below the rule-of-thumb value of ten (Wooldridge, 2012). It is possible to observe a moderate correlation between *licensor's core technology* and the *number of employees*, indicating that larger firms are less likely to license core technologies. We expect this relationship to be caused by the fact that larger firms also have a more diverse patent portfolio (less specialized) given their capacity to operate in different technological fields simultaneously. Finally, we used the likelihood ratio test to check how the stepwise inclusion of the variables change the likelihood statistics, the results indicate a significant improvement in the overall fit of the model 7 (*likelihood ratio*: 80.506, $p<0.001$) .

[*Insert Table 1 around here*]

Table 2 reports the results for the fixed-effects model with robust standard errors. The dependent variable across the seven models reported in this table regards the relative changes in the licensors market-share in the year subsequent to the licensing deal. Model 1 reports the estimators for the control variables. Model 2 introduces the main independent variable *licensor's core technology*. The variables *technological overlap* and *licensee size* are entered into the Models 3 and 4 respectively. The two-way interaction between *licensor's core technology* and *technological overlap (low)* is estimated in the model 5. At model 6 the interaction between *licensee size* and *licensor's core technology* is included in the regression. Finally, model 7 is estimated included all explanatory variables.

Hypothesis 1 predicted that the closer a technology to the licensor's core technological activities, the stronger the dissipation effect. Accordingly, the results of Table 2 indicate that the coefficient for the *licensor's core technology* variable is negative and significant at 1% level when all controls are included in the equation, providing strong evidences in favor of our first hypothesis. This result lends support to one of the main ideas proposed in this paper that the closer the licensed technology to the licensor's main technological activities, the stronger will be the rent dissipation effect experienced in the product market. Hypothesis 2 predicts that the larger the licensee firm, the stronger will be the dissipation effect caused by licensing core technologies. As reported in table 2, the interaction term between *licensor's core technology* and *licensee size* presents consistently a negative and significant coefficient across the models, suggesting that licensee size negatively moderates the relationship between licensing core technologies and subsequent changes in the licensor's market-share. This result offer support to the relationship stated in hypothesis 2. Finally, hypothesis 3 predicts that the lower the level of technological overlap between licensor and licensee will decrease the negative effect of licensing-out core technologies and the licensor's market-share. The statistical significant and positive coefficient for the interaction between *licensor's core technology and Technological Overlap (low)* lends support for hypotheses 3.

[*Insert Table 2 around here*]

Concerning the control variables, the results indicate a negative and significant effect of sub-licensing on the dependent variable. This result goes in the same direction of our expectations, indicating that signing licensing contracts with a sub-licensing clause are negatively related with subsequent changes on the licensor's market-share. Indeed, the fact that the licensee is able to transfer the commercialization rights of a specific technology to other firms is likely to increase the number of potential competitors that will also use the licensed technology to compete against the licensor.

2.4.2. Supplementary Analysis

The literature on markets for technology describes the 'dilemma' that licensors face when deciding to license-out a technology (Fosfuri, 2006). On one hand, licensing creates dissipation effect caused by increasing competition in the product market (Arora & Fosfuri, 2003; Choi, 2002), which we operationalize based on a relative change on the licensor's market-share. On the other hand, the decreasing shares in the product market experienced by the licensor should be compensated with licensing revenues; otherwise firms would have no stimulus to enter into licensing or other forms of technology exchange (Choi, 2002). In this paper we focus on the dissipation effect caused by licensing core technologies and two main contingencies regarding the licensee size and the overlap between licensor and licensee. Given the scarcity of empirical evidences on this topic this focus contributes to a better understanding of the rent dissipation effect as an important part of the markets for technology dynamics. Although relevant, it is still only a partial picture of the licensing 'dilemma'. Unfortunately, the dataset combination that we used to test the proposed hypotheses does not allow us to extract information about the revenue generated by each licensing deal. As a consequence, we are not able to test if the licensing revenues will increase as the dissipation effect also increases. However, looking into each individual contract we were able to extract certain information regarding the remuneration structure of each deal in order to supplement the main analysis regarding the rent dissipation effect.

In order to do so we estimated an additional econometric model based on the remuneration conditions of the licensing contracts. We generated a dummy variable that takes value 1 if the licensing contract includes a granted minimum royalty clause. This clause indicates that the licensor will receive a given minimum royalty independently from the licensee's performance in exploiting the licensed technology, even if it is necessary the licensee to supplement the royalty payment to achieve the stipulated amount (Battersby & Grimes, 2005). Apart from being a contractual mechanism to ensure that the licensor will receive monetary compensation regardless of licensee's performance, this contractual specification can be also used as a way to guarantee that the licensee will not use the licensing agreement to avoid or delay the introduction of a competitive technology in the market (Goldscheider, 1995; Welch, Benito, & Petersen, 2008). Accordingly, this clause can be applied in contracts transitioning valuable technologies with high potential to generate revenue and which the licensor wants to avoid becoming licensee's hostage in terms of revenue generation. Indeed according Goldscheider "*minimum royalties may also be used to eliminate licensees who cannot perform adequately by providing a mechanism to "weed out" the unsuccessful licensees*" (1995, p.12). Therefore, we generated a dependent variable calculated based on a binary outcome with the observations taking value 1 if the contract includes the payment of minimum royalty fees and 0 otherwise. Consequently, we expect that the main independent variables used to predict the dissipation effect equation will have the opposite direction when estimated against this dependent variable capturing the remuneration conditions of a licensing deal. We expect that the negative and significant effect that licensing a core technology has on the licensor's market-share, will be positive in terms of the likelihood that this remuneration clause will be evoked. Following this logic, we also expect the opposite moderating effects for licensee size and technological overlap.

Considering the discrete nature of the dependent variable we used a logit model with robust standard errors to estimate the likelihood that this clause will be used in a licensing contract simultaneously. We included the same explanatory variables used in the fixed effects model, apart from the variable *Royalty Sales* and the licensor market-share in the year prior to the licensing date.

[Insert Table 3 around here]

In line with our expectations we find a positive and significant effect of the licensor's core technology on the likelihood that the licensing contract will include a minimum royalty fee clause. This result suggests that the licensor is more likely to require safer remunerations conditions (that do not depend on licensee performance) as a way to compensate the dissipation effect caused by licensing-out core technologies. Examining the interaction between the licensor's core technology and technological overlap (low) between the licensor and the licensee we also find support to the idea that low levels of overlap between both parts negatively moderate the relationship between core technology and remuneration conditions. Our results don't lend support to the moderating effect that licensee size is expected to have on the remuneration conditions of licensing contracts.

2.5. Discussion and Conclusions

This article starts by developing a conceptual model to explain the rent dissipation effect using the concepts found in the markets for technology literature. Despite the fact that the dissipation effect has been recurrently mentioned as one of the main dimensions of technology licensing, only few studies have examined this topic. In this paper, we focus on the extent to which the licensed technology represents a licensor's core technology. We posit that licensing core technologies is more likely to increase the dissipation effect caused by the existence of product market downstream assets. Furthermore, we incorporate into our model the licensee's point of view by considering that licensee size plays an important moderating role in strengthening the negative effect caused by licensing core technologies. Finally, we draw on recent advances in the markets for technology literature and test the effect of technological overlap in the context of licensing contracts. Indeed, the fact that the licensor and the licensee operate in different technological niches within the same industry alleviates the rent dissipation effect experienced by the licensor.

The results should also be considered in light of some limitations. First, the literature on markets for technology conceptualizes the dissipation effect as a direct effect of increasing competition on the licensors product market. However, the way that we are able to operationalize our dependent variable does not allow distinguishing between a relative reduction in the licensor's current market share as a consequence of more fierce competition and the cases in which firms purposefully choose to reduce its share in the product market (e.g., licensing-out a specific line of business). This is a limitation that future research should try to deal with. Second, although we try to rule-out issues with reverse causality (a firm licenses a core technology because is experiencing financial problems), it could be possible that other unobserved factors related to firm performance can lead to the decision to license core technologies. However, we believe that the use of a fixed effects associated with several firm, technology and industry control variables used in the econometric model offers a robust setting to minimize such concerns. Third, our proxy for how core a technology is to the licensor is based patenting information, the most appropriate solution would be the use of measure connecting the licensed technology directly with produce market. Nevertheless, several studies have indicated patent data to be a robust indicator for firm technological activities which is naturally reflected in the firm's product market. Fourth, despite the fact that we believe the number of patents to be a reliable proxy for licensee size, further studies should use a more precise measure that allows examining how the licensee downstream assets affect the rent dissipation. Finally, the results are not directly generalizable; the pharmaceutical industry is a specific case in which the several characteristics offer the necessary conditions for a well-functioning market for technology where patents work as the main appropriability strategy. Despite those limitations we believe that this paper contributes by shedding light on important, and relatively unexplored, dimensions of the licensing literature. We encourage future research to explore further the contingencies related to the dissipation effect against empirical data. In this line, a possible extension would be how firms can use the contractual design of licensing contracts to prevent licensees from becoming potential competitors.

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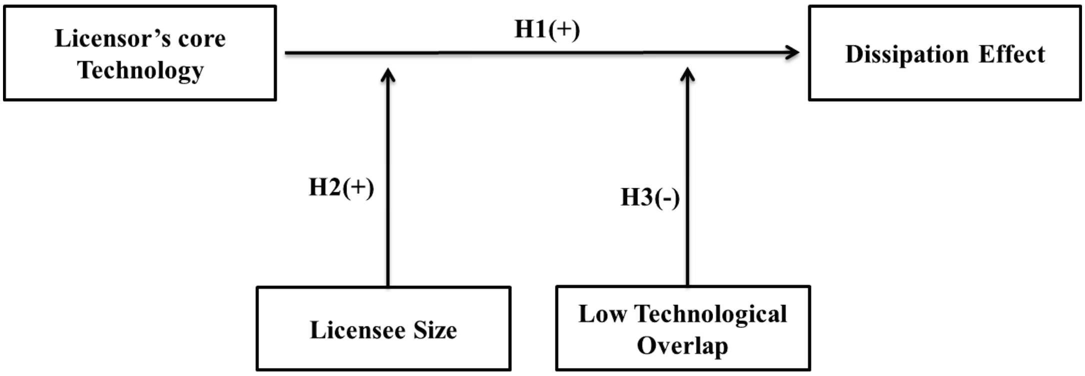
2.7. Appendix

Figure 1. Conceptual Model



2.8. Tables

Table 1. Descriptive Statistics and Correlations Coefficients (N = 334)

	Variables	Mean	S.D.	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
[1]	*Licensor's core Technology*	0.35	0.30	1.00							
[2]	*Technological Overlap (Low)*	0.70	0.34	-0.12	1.00						
[3]	*Log(Licensee Size)*	3.32	2.67	0.19	-0.25	1.00					
[4]	*Previous Change on Licensor's Market Share*	0.02	0.99	-0.10	0.02	-0.01	1.00				
[5]	*R&D Intensity*	3.87	15.37	0.04	-0.09	0.11	-0.32	1.00			
[6]	*Log (Employees)*	5.96	2.68	-0.35	0.10	-0.37	0.01	-0.17	1.00		
[7]	*Licensor Technological Specialization*	0.40	0.24	0.46	-0.02	0.21	-0.04	0.01	-0.47	1.00	
[8]	*Sub-Licensing*	0.73	0.45	0.17	-0.02	-0.00	-0.05	0.04	-0.11	0.08	1.00
[9]	*Exclusivity*	0.74	0.44	0.21	0.01	0.08	-0.01	0.07	-0.21	0.21	0.44
[10]	*Royalty Sales*	0.85	0.36	0.02	0.03	-0.00	-0.05	0.07	-0.04	-0.02	0.07
[11]	*License Development*	0.70	0.46	0.09	-0.16	-0.00	0.07	-0.06	-0.13	0.16	0.25
[12]	*Technology Value*	95.62	213.35	-0.11	-0.02	0.02	0.01	-0.03	0.13	-0.01	-0.22
[13]	*Technology Age*	6.65	3.69	-0.20	-0.00	-0.14	0.05	0.10	0.19	-0.16	-0.12

	Variables	Mean	S.D.	[9]	[10]	[11]	[12]	[13]
[9]	*Exclusivity*	0.74	0.44	1.00				
[10]	*Royalty Sales*	0.85	0.36	0.05	1.00			
[11]	*License Development*	0.70	0.46	0.17	0.09	1.00		
[12]	*Technology Value*	95.62	213.35	-0.23	0.02	-0.11	1.00	
[13]	*Technology Age*	6.65	3.69	-0.22	0.01	-0.15	0.13	1.00

Table 2. Results of Fixed Effects Panel Linear Regression Analysis Predicting Dissipation Effect (Robust Standard Errors)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Licensor's core Technology		-1.179**	-1.440**	-1.440**	-1.402**	-1.368**	-1.351**
		(0.441)	(0.439)	(0.435)	(0.420)	(0.419)	(0.413)
Technological Overlap (Low)			-0.685**	-0.712**	-0.753**	-0.724**	-0.758**
			(0.224)	(0.229)	(0.237)	(0.229)	(0.236)
Licensee Size				-0.012	-0.014	-0.006	-0.010
				(0.026)	(0.026)	(0.026)	(0.027)
Licensor's core Technology x Technological Overlap (Low)					1.403*		1.250*
					(0.618)		(0.608)
Licensor's core Technology x Licensee Size						-0.128*	-0.098+
						(0.062)	(0.059)
Previous Change on Licensor's Market Share	-0.338**	-0.337**	-0.351**	-0.349**	-0.352**	-0.347**	-0.350***
	(0.128)	(0.111)	(0.107)	(0.110)	(0.107)	(0.106)	(0.104)
R&D Intensity	-0.010	-0.011+	-0.013+	-0.012+	-0.014*	-0.013*	-0.014**
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Log (Employees)	0.112	0.161	0.166	0.173	0.121	0.216	0.160
	(0.223)	(0.224)	(0.194)	(0.193)	(0.192)	(0.182)	(0.181)
Licensor Technological Specialization	0.085	0.361	0.090	0.094	-0.254	0.230	-0.111
	(0.719)	(0.649)	(0.581)	(0.582)	(0.618)	(0.537)	(0.571)
Sub-Licensing	-0.306*	-0.324*	-0.303*	-0.303*	-0.255+	-0.251+	-0.221
	(0.137)	(0.140)	(0.146)	(0.146)	(0.140)	(0.143)	(0.141)
Exclusivity	-0.049	-0.035	0.002	-0.003	0.022	-0.035	-0.005
	(0.151)	(0.157)	(0.157)	(0.154)	(0.154)	(0.145)	(0.147)
License Development	0.022	-0.000	-0.106	-0.110	-0.075	-0.131	-0.095
	(0.116)	(0.118)	(0.113)	(0.112)	(0.103)	(0.109)	(0.100)
Royalty Sales	0.113	0.077	0.103	0.106	0.054	0.063	0.027
	(0.159)	(0.162)	(0.140)	(0.139)	(0.137)	(0.147)	(0.143)
Technology Value	0.003	0.030	0.039	0.039	0.052	0.033	0.046
	(0.021)	(0.027)	(0.028)	(0.028)	(0.033)	(0.026)	(0.031)
Technology Age	0.833	0.793	0.317	0.313	0.840	0.382	0.835
	(2.186)	(2.074)	(1.821)	(1.813)	(1.698)	(1.793)	(1.698)
Technology Field Dummy	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES
Constant	0.767	0.720	1.007	1.024	1.385	0.855	1.215
	(1.308)	(1.305)	(1.122)	(1.123)	(1.129)	(1.060)	(1.070)
Number of observations	330	330	330	330	330	330	330
R2	0.348	0.416	0.461	0.462	0.483	0.473	0.489
Ll	-195.045	-176.932	-163.597	-163.348	-156.849	-159.843	-154.792
Likelihood ratio comparison	-	36.226***	62.896***	63.395***	76.391***	70.403***	80.506***

+ p<0.10, * p<0.05, ** p<0.01, ***p<0.001 at a two sided test, Standard errors in parentheses

Table 3: Results of logit Model Predicting Remuneration Clauses (Robust Standard Errors)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Licensor's core Technology		1.546*	1.765*	1.822*	2.065**	1.819*	2.117**
		(0.694)	(0.742)	(0.736)	(0.751)	(0.760)	(0.792)
Technological Overlap (Low)			1.199+	1.375*	1.712*	1.374*	1.732*
			(0.657)	(0.666)	(0.694)	(0.669)	(0.701)
Licensee Size				0.075	0.086	0.075	0.090
				(0.064)	(0.066)	(0.064)	(0.067)
Licensor's core Technology x Technological Overlap (Low)					-4.060*		-4.155*
					(1.670)		(1.657)
Licensor's core Technology x Licensee Size						0.006	-0.067
						(0.207)	(0.205)
R&D Intensity	-0.001	-0.002	-0.000	-0.001	-0.002	-0.001	-0.002
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)
Log (Employees)	0.141+	0.161*	0.147+	0.175*	0.172*	0.174*	0.180*
	(0.076)	(0.077)	(0.078)	(0.081)	(0.085)	(0.086)	(0.088)
Licensor Technological Specialization	0.925	0.072	-0.128	-0.277	-0.172	-0.281	-0.128
	(0.764)	(0.866)	(0.945)	(0.955)	(0.968)	(0.967)	(0.975)
Sub-Licensing	0.293	0.229	0.173	0.145	0.066	0.144	0.068
	(0.414)	(0.410)	(0.412)	(0.408)	(0.413)	(0.407)	(0.416)
Exclusivity	0.328	0.384	0.361	0.391	0.497	0.392	0.493
	(0.387)	(0.388)	(0.385)	(0.384)	(0.395)	(0.385)	(0.397)
Royalty Sales	2.652*	2.673*	2.588*	2.665*	2.732*	2.665*	2.740*
	(1.064)	(1.099)	(1.086)	(1.133)	(1.117)	(1.134)	(1.116)
Technology Value	-0.056	-0.027	-0.022	-0.020	-0.026	-0.020	-0.028
	(0.112)	(0.101)	(0.111)	(0.112)	(0.101)	(0.112)	(0.101)
Technology Age	1.238	2.939	3.385	3.664	2.492	3.662	2.484
	(5.015)	(4.947)	(4.959)	(5.107)	(5.347)	(5.104)	(5.362)
License Development	-0.001	0.052	0.197	0.224	0.189	0.226	0.168
	(0.443)	(0.430)	(0.445)	(0.446)	(0.455)	(0.454)	(0.468)
Technology Field Dummy	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES
Constant	-4.128*	-3.661*	-3.603*	-3.970*	-4.273**	-3.965*	-4.338**
	(1.666)	(1.711)	(1.582)	(1.607)	(1.638)	(1.616)	(1.644)
Number of observations	319	319	319	319	319	319	319
ll	-126.718	-124.303	-122.162	-121.593	-119.537	-121.593	-119.491
Chi2	56.995**	59.016**	63.575***	66.565***	68.624***	69.949***	69.694***

+ p<0.10, * p<0.05, ** p<0.01, ***p<0.001 at a two sided test, Standard errors in parentheses

CHAPTER 3 - Sources of Appropriation Capacity in Licensing Agreements

3.1. Introduction

Transactions in markets for technology have significantly increased during the last two decades (Arora et al. 2001, Sheehan et al. 2004; Robbins, 2006; Athreye & Cantwell, 2007). The rapid development of the information and technology sector, the intensive competition, the dynamic changes in customer needs and the shorter product life-cycles have forced effective companies to rely on both in-house research and external sources of knowledge. As a consequence, the volume and the importance of licensing agreements have both increased remarkably (Zuniga and Guellec, 2009; Kamiyama, 2006; Conti et al. 2013). Nowadays, it represents one of the most important options available to transfer technology (Anand & Khanna, 2000b; Arora & Fosfuri, 2003). In fact, given its significance, the U.S. Department of Justice has defined markets for technology as "markets that consist of intellectual property that is licensed and its close substitutes" (U.S. Department of Justice, 1995). Indeed, in several industries licensing has become an integral part of firms' strategy to appropriate value from innovation (Gans & Stern, 2003).

Consistently, licensing has attracted increasing attention in the management literature. In this area, research has mainly focused on analyzing the strategic determinants that influence the licensing decision (Gans et al., 2008; Gambardella *et al.*, 2007; Kani and Motohashi, 2012; Bianchi *et al.*, 2011; Cockburn *et al.*, 2010; Kim and Vonortas, 2006; Fosfuri, 2006), on quantifying the transactions in markets for technology (Arora et al. 2001; Sheehan et al. 2004; Robbins, 2006; Athreye and Cantwell; 2007), on proposing the optimal licensing payment form (Katz and Shapiro, 1985; Gallini, 1984; Gallini and Winter, 1985; Kamien and Tauman, 1986; Rockett, 1990; Bousquet et al. 1998; Vishwasrao, 2007) and on studying the relationship between licensing-in and firm performance (Zahra, 1996b; Jones et al., 2001;Rothaermel et al., 2006; Cassiman and Veugelers, 2006; Tsai and Wang, 2007). However, to the best of my knowledge, previous research has not put much emphasis on the factors that influence the appropriation capacity of the parties involved in the agreement. The main reason that explains this lack is the no availability of uniform licensing data: licensing agreements are confidential and it is not compulsory for companies to report licensing revenues as a separate item in the income statement. Hence, previous research in licensing has relied on cumulative abnormal returns (CARs) as a market based measure of performance (Annand and Khanna, 2000b and

Walter, 2012). Specifically, Anand and Khanna (2000b) found that licensing agreements in general generates CARs equal to 3.13% over a 14-day window, but they did not distinguish between the parties and just found one significant determinant of cumulative abnormal returns: licensing experience. On the other hand, Walter (2012) showed that CAR for licensors is almost double that for licensees (2.00% vs 1.06%) and he also pointed out four different determinants that impact it: firm size, R&D intensity, business relatedness and industry. Nevertheless, it is very important to conduct a deeper analysis of the stock market reaction to the announcement of licensing agreements. This empirical question is important for the following reasons. First, in an efficient market the current share price is the best available estimate of a company true value (Akhtar, F. and Oliver, B., 2009). Second, previous research has demonstrated that the initial stock market response to a key event positively correlates with the long-term performance of the company and the value of the event (Kale et al. 2002). Third, usually managers' compensation is linked to the company market value. As a result, in order to maintain their job and their reputation and to receive a higher salary managers will not make any strategic decision that could negatively influence this variable. Fourth, it is necessary for companies to understand the signal that the market perceives at the time to license their technology: if a company is licensing out its technology, does the market view it as a signal of superior technology or a signal of lack of capability to commercialize the technology by itself?

This study analyzes the determinants of licensors' appropriation capacity at the moment they announce a licensing agreement. In particular, I argue that licensors' appropriation capacity is a function of their bargaining power and the potential costs of imitation. Regarding bargaining power, I posit that it is determined by the existence of financial constraints in the company and the presence of information asymmetries between parties. First, previous literature has noted that financial constraints erode the bargaining power of companies (Aghion and Tirole, 1994; Lerner and Merger, 1998), so I hypothesize that companies with cash constraints, as a consequence of their weak bargaining power, appropriate fewer benefits from licensing than companies that are not cash constrained. Second, previous research has demonstrated that incomplete information reduces the bargaining power of the company (Chattejee & Samuelson, 1983). Thus, I hypothesize that licensors are better able to appropriate benefits from licensing when they license out in the same sector (characterized by lower information asymmetries) than when they license out to another sector (characterized by higher information asymmetries). Since bargaining power in each situation determines licensors' success and the level of rewards in the agreement (Kim, 1997; Mannix, 1993a; Pinkley, Neale, and Bennett, 1994), I expect it to increase the licensor's appropriation capacity in terms of market value. When it comes to the potential cost of imitation, I argue that it has a negative influence on licensors' appropriation capacity. Since the threat of imitation increases with licensors' greater market share (Arora and

Fosfuri, 2003), I hypothesize that licensors that lead a specific sector (i.e. have the highest marker share) appropriate fewer benefits from licensing than those that are followers.

To test these hypotheses, I used a sample of 260 licensing agreements between U.S. high-tech public companies during 1998–2009. Licensing data came from four different sources: Prompt Database, Google, Highbeam Research, and SDC Platinum. To analyze the impact on licensors' market value at the time of announcing the contract, I ran an event study around the announcement dates using a two-day event window (-1,0). In order to obtain the average cumulative abnormal returns I followed Flammer's (2013) procedure: I computed abnormal returns using the market model, estimated the coefficients with ordinary least squares based on 200 trading days [-240, -41], and employed the daily return of the equally weighted market portfolio as a reference. To determine if the proposed contingencies have different impacts on licensors' appropriation capacity, I designated six subsamples. As a robustness checks I considered (-1,1) and (-3,3) event windows under the market model and I also checked if my results were influenced by the choice of the model or the choice of the reference portfolio using the market adjusted model and the value weighted index as well. In addition, as second hypothesis provides us insights regarding the choice of the sector and the third one regarding the relative position of the company in the sector, I explore their combined effect on CARs in conjunction, considering four additional cases.

The results of this study show that (1) companies with cash constraints appropriate fewer benefits from licensing than companies with no cash problems in terms of market value (1.10% vs. 2.65%); (2) companies that license out under low information asymmetries (same sector) benefit more from licensing than do companies that license out under high information asymmetries (different sector), in terms of market value (7.27% vs. 1.53%); (3) leaders in the sector benefit much less from licensing, in terms of market value, than companies that follow (0.61% vs. 3.86%); (4) in the specific context of licensing out in the same sector, leaders appropriate much less value than companies that follow (0.73% vs. 8.46%); and (5) the difference between being a leader and being a follower is less important when a company licenses out to a different sector (0.59% vs. 2.19%).

This study contributes an analysis of value appropriation in licensing agreements. Just Walter (2012) has addressed the benefits appropriated by each individual partner proposing four determinants that influence the impact on the stock market. I seek to improve our understanding of licensors' appropriation capacity, through an analysis of company, sector, and industry factors. Furthermore, this article provides evidence of the licensing trade-off. Fosfuri (2006) theoretically describes the dilemma that licensing entails but does not show empirically how both effects interact. This paper uses market value to explicate the effect of this trade-off empirically. Specifically, by observing licensors' market value, I can determine how their appropriation capacity increases with contingencies that determine the bargaining power but declines when there is a high potential cost of imitation.

The remainder of this paper is organized as follows. Section 2 presents literature review and hypotheses development. Section 3 describes the data, variables and methodology. Section 4 reports the results and robustness checks and Section 5 concludes with a discussion of the results and their managerial implications.

3.2. Theory and Hypotheses Development

Over the last decades a new way to manage R&D innovations has emerged. With strong competition in the product market, shorter product life cycles, and robust growth in information and communication technologies, companies cannot produce everything by themselves (Zuniga and Guellec, 2009). Increasingly, they must trust networks, new entrants, and technology-based firms if they want to remain efficient and competitive. Licensing agreements thus have increased in importance and volume, to become the most important method for commercializing and diffusing new technologies outside the firm (Anand and Khanna, 2000; Hagedoorn, 2002; Somaya et al. 2010).Despite this surge in popularity, establishing a licensing agreement is not an easy task. Markets for technology are mainly characterized by asymmetric information between parties, difficulties in describing and valuing the technology, uncertainty about the validity and applicability of the traded technology, and the risk of opportunistic behavior by licensees. Thus it is reasonable to expect that parties do not appropriate the total profits generated by the agreement equally; neither the licensor nor the licensee can know precisely the true value of the technology (Dwyer & Walker, 1981).

Therefore, the output of any negotiation depends on the specific characteristics of the company, sector, and industry in which each licensing agreement is signed. However, while previous research in licensing deeply analyzed the strategic benefits surrounding the establishment of these contracts (Telesio, 1979; Katz & Shapiro, 1985; Shepard, 1987; Farrel & Gallini, 1988; Rockett, 1990; Lei and Slocum, 1991; Lowe and Taylor, 1999; Saphiro, 2001), research regarding their economic benefits is scarce. In this vein, previous research has mainly focused on explaining, through the use of surveys, that licensing revenues is one of the main motivations for companies to license out (Gambardella et al. 2007; Robbins, 2008; Zuniga and Guellec, 2009). However, these studies focused on quantifying the benefits from licensing on markets for technology at an aggregate level (Arora et al. 2001; Sheehan et al. 2004; OECD,2006; Robbins, 2006; Athreye and Cantwell; 2007).

Researchers did not pay attention to the economics benefits at the firm level. To the best of my knowledge, Walter (2012) offers the only study that analyzes the licensing benefits appropriated by each party in the agreement. Specifically, analyzing 11 years of licensing in the U.S. computer and pharmaceutical sector, Walter uses abnormal stock market returns to distinguish the impact of licensing on the licensor versus the licensee. The results show that average cumulative abnormal returns (CAR) for licensors are almost double those for licensees (2.00% vs. 1.06%). In addition, this study pointed out four determinants that influence the impact on the stock market: firm size (positive), R&D intensity (positive), business relatedness (negative), and industry (varying).

Considering the strategic corporate implications that such knowledge implies, it seems very important to analyze in greater depth which factors determine appropriation levels at the time of a licensing agreement. No doubt, this will help managers to take better advantage of their technologies and to be conscious of the impact of announcing a licensing agreement.

Accordingly, in this paper I analyze how licensors' appropriation capacity varies at the time they announce a licensing agreement. This appropriation capacity should depend on two main factors: bargaining power and the potential cost of imitation. The former should be a function of the existence of financial constrains in the company and the presence of information asymmetries between the parties. With more bargaining power, the licensor can demand more rewards in the agreement (Kim, 1997; Mannix, 1993a; Pinkley, Neale and Bennett, 1994), so I expect it to increase the licensor's appropriation capacity. However, because the cost of imitation is a function of the relative position that the licensor has in a sector (leader vs. follower), I expect it to hinder the licensor's appropriation capacity, in terms of market value.

3.2.1. Bargaining Power: Cash Constraints

Consider a company that has successfully developed a commercial innovation and must choose between entering the product market (commercialize the final product) or licensing out the innovation to another company. The choice depends on the net benefits resulting from each option (Gans, Hsu and Stern, 2002). Companies compare the benefits of developing the final product on their own (e.g., revenues from sales in the product market, less the costs of acquiring complementary assets, hiring personnel, and buying necessary raw material) against the benefits of licensing out (e.g., lower transaction costs, less a potential decrease in market share by creating more competition). Although the optimal decision is the one that maximizes benefits, several factors might impede it. For example, companies with cash constraints rarely can develop the product by themselves. As they lack the needed financial resources it is unlike that they decide to commercialize the product instead licensing out their technology. Thus, licensing out is often their only option to recover previous investments in R&D. Therefore, following Fisher and Ury's (1981) claim that the bargaining power of the company relates positively to the number of options that companies have, I expect companies that are having cash constraints to have lower bargaining power than companies that do not.

In addition, Lerner and Merges (1998), consistent with the framework developed by Aghion and Tirole (1994) and in an attempt to examine the determinants of the allocation of control rights in alliances, show that the greater their financial resources, the fewer control rights R&D firms allocate to financial firms. They provide three cases in which internal financial trouble influenced the final outcome of the contract negotiation suggesting that companies with cash constraints have lower bargaining power at the time of negotiation.[28]

Therefore, as the bargaining power of the company relates positively to the number of options they have (Fisher and Ury, 1981) and companies with cash constraints have lower bargaining power at the time of negotiation (Lerner and Merges, 1998), I posit that companies facing cash problems suffer from lower bargaining power and, thus, they should appropriate less value from licensing than companies without cash constraints.

H1. All else being equal, licensors with short-term cash problems capture lower abnormal market returns from licensing out technology than licensors that face no cash constraints.

3.2.2. Bargaining Power: Information Asymmetries

Markets for technology are characterized by asymmetric information between parties, difficulties describing and valuing the focal technology, and uncertainty about the validity and applicability of the traded technology (Caves et al. 1983; Gallini & Wright, 1990; Arora & Gambardella, 2010). However, the influence of asymmetric information on the licensor's bargaining power varies when the licensing agreement includes companies that belong to the same sector (low information asymmetry) or different sectors (high information asymmetry). Thus researchers generally analyze these two cases separately (e.g., Walter, 2012; Müllez-Seitz, 2012).

[28] One example they offer is the alliance between ALZA and Giba-Geigy. When negotiating the alliance, ALZA confronted a major financial crisis. In turn, the alliance agreement assigned almost total control to Ciba-Geigy: It had a supermajority on the joint board that reviewed and approved potential research projects, the right to license and manufacture any of ALZA's current or future products, the ability to block any other alliances that ALZA sought to enter, and eight of the eleven seats on ALZA's board of directors. In addition, Ciba-Geigy received a new class of preferred shares. If converted into common stock, they would represent 53% of the equity in ALZA. Prior to this conversion, Ciba-Geigy had 80% of the voting rights, an allocation that allowed it to employ ALZA's tax losses (Lerner and Merges, 1993).

The rationale for this distinction is that asymmetric information diminishes significantly if the licensor belongs to the same sector as the licensee. First, companies in the same sector can more readily detect opportunistic behavior, understand the agreement and its potential, and establish and communicate a common objective (Koh and Verikatraman, 1991). Second, the similarity of companies in a sector suggests lower uncertainty and lower transaction costs. Both licensors and investors then should have more confidence in the selection decision, because they possess good information about the technology, the company, and the sector in which they operate (Baladrishnan and Koza, 1993).

If companies license out to a company that belongs to a different sector, licensing instead represents a way to enter a new market. With this option, companies can recover returns on their innovative effort, without having to invest additional time or money to develop new sector-specific assets and knowledge. Yet in this case, the bargaining power of licensors also is much lower. They face greater information asymmetries and uncertainty, because they do not know the new sector, do not fully understand how the technology will be used, and lack any previous experience to help them anticipate opportunistic behavior. Therefore, when companies function in different sectors and the licensor seeks to expand its technology to another market, a shift in bargaining power occurs, in that licensors become dependent on licensees to generate returns. Their only other option is more time consuming and requires a greater monetary investment.

Licensors thus should appropriate more value from licensing out when they deal with a company that belongs to the same sector. If they deal with a different sector, they face uncertainty and information asymmetries in relation to the sector, the technology, and the company. In this case, licensors depend more on the partner’s efforts to extract some benefit from their technology. Accordingly, I hypothesize that companies that license out to a company in the same sector appropriate more value than companies that license out to a company that belongs to a different sector, because of their greater bargaining power.

H2. All else being equal, licensors that license out their technology to companies that belong to the same sector capture greater abnormal market returns from licensing out technology than do licensors that license out to companies in other sectors.

3.2.3. Costs of Imitation: Leader/ Follower

Through their licensing agreements, licensors grant access to secrets about their technology and allow licensees to use it. After internalizing and understanding how the licensed technology works, the licensees thus could invent around the technology, imitate licensors, and compete directly with them in the product market. Such additional competition would reduce the licensors' benefits by an amount equal to the cost of imitation, that is, the difference between licensors' benefits in the product market without imitation and their benefits with imitation. The importance of this cost depends on the presence of the licensor in the product market. Arora and Fosfuri (2003) show that when market share before licensing is small, the reduction implied by imitation is almost insignificant, because each company internalizes just a small loss. In contrast, when companies have higher market shares, the impact of imitation could be very strong: They suffer significantly reduced market share or price–cost margins due to the additional competition in the product market.

Therefore, the potential cost of imitation is higher for leaders than for followers in a specific sector. Leaders usually have the largest market share in the sector, along with accumulated experience in their business and huge investments in fixed assets. Because they often own complementary assets, they can benefit from economies of scale in R&D, achieve faster learning curves, and understand how to commercialize the technology. In this sense, a significant portion of company benefits depends on leaders' activity in the product market, so the impact of imitation could be very negative in terms of competitive advantage. Followers instead tend to be firms with small market shares, which lack both the downstream assets needed to commercialize the final product (e.g., distribution channel, marketing, manufacturing) and the legitimacy in the marketplace needed to leverage incurred R&D expenditures. Therefore, licensing may represent the only way to recover their previous investments (Teece, 1986; Kollmer and Dowling, 2004), establish relationships with large companies, and enhance their reputation (Teece, 1986; Stuart et al. 1999; Shane and Venkataraman, 2000). Followers have incentives to license out their technology: They have much to earn from licensing and little to lose in the product market. Because leaders have more to lose from licensing than followers, I predict they appropriate fewer benefits from licensing, in terms of market value, than followers.

H3. All else being equal, licensors that lead a specific sector capture fewer cumulative abnormal returns from licensing out technology than do licensors that are followers.

Figure 1 represents the relationships analyzed herein.

3.3. Data, Variables and Methodology

3.3.1. Sample Selection and Data

The empirical analysis is based on a sample of innovative U.S. companies, selected according to several criteria. First, I identified 140 companies with the most granted patents from the U.S. Patent and Trademark Office (USPTO) during 1990–2009.[29] Because my main objective was to analyze how the licensors' appropriation capacity varies in terms of market value I focused on potential licensors, namely, companies with technological assets to license. Second, considering the easy access to information and the size of their market for technology,[30] I narrowed the initial sample to U.S. companies. Licensing data are per se difficult to find; this search process becomes nearly impossible in countries in which information about companies is less accessible and markets for technology are smaller. Third, because I used the stock market value of the company as a proxy for appropriation capacity, I retained only those agreements in which both companies were public. Fourth, because they did not fit with my theoretical focus and could have totally different impacts on market value, I eliminated cross-licensing agreements and agreements enforced by a settlement. Unfortunately, many U.S. innovative companies are characterized by exactly these features, which means the results are less generalizable. However, noting the scarce evidence related to this topic, I purposefully chose this setting to improve understanding of an important and unexplored relationship: how licensors' appropriation capacity varies in different situations.

The licensing data came from four sources: Prompt database, HighBeam Research, Google News, and SDC Platinum. The first three sources use press news; the latter is an established licensing database. In the Prompt, Google News, and HighBeam Research databases, I looked for licensing agreements using key words, namely, "licensing agreement" plus the company name or "licens" plus the company name. In Prompt and HighBeam Research, I read all the results; in Google I checked them up to the twentieth page. After reading the news and corroborating that each announcement referred to a license agreement, I collected and codified the information. From these stories, I was consistently able to extract the announcement date (if the same agreement listed different dates, I selected the earlier one), licensor's name, and licensee's name. I next appended these licensing agreements to those I obtained from SCD

[29] I choose a period of almost 20 years because of the normal length of a patent. If the USPTO granted a patent to a company in 1990, it would still be valid at the end the study period.
[30] Arora et al. (2001) indicate the annual value of transactions in markets for technology was $25–35 billion in the United States and $35–50 billion globally. The British Technology Group (1998) estimates the size of the market at $25 billion in North America and $6.6 billion in Europe.

Platinum, which provided information about joint ventures, marketing agreements, and licensing agreements, among other forms of contract. As Anand and Khanna (2000a) have shown, information regarding contract dates from SCD is highly inaccurate, so I manually checked each date, using the names of the parties involved, with a Google search for "name of company 1" "name of company 2" "licens agreement." The extent of inaccuracy in my sample was not as great as that reported by Anand and Khanna (2000a). The date variance was from one to ten days, probably due to the different criteria used to select dates. In an event study though, data accuracy is critical, and my window is very narrow, so to avoid any biases, I always selected the first possible date.

Using the licensor's and licensee's names, I next sought corresponding firm level identifiers (gvkey and permno), then matched licensing data with Compustat financial data and stock market data from CRSP. The final licensing output featured 260 licensing agreements during 1998–2009. Finally, I manually checked if the day of the licensing announcement companies also announced other news that could influenced my results. Coincidences were not found.

A potential concern regarding this data collection is the possibility that I did not capture the entire universe of licensing agreements. In general, licensing agreements are private and confidential. Companies do not have to report licensing agreements in their income statements, and even in countries with regulatory reporting requirements, they refer only to cross-border transactions. Therefore, I might not have captured all the licensing agreements established by these companies, though my focus on companies from the same country and same information environment, with the same characteristics (public companies with most patents granted), reduced the chances that I would obtain more news from one company than from another. Accordingly, bias due to any systematic variation in tracking these companies is unlikely.

3.3.2. Variables

3.3.2.1. Dependent Variable: Cumulative Abnormal Returns (CARs).

For each firm *i* (Kale et al. 2003; Gulati et al. 2009), I computed the abnormal returns using the market model (Fama et al., 1969), which assumes a stable linear relationship between market returns and returns on the financial instrument, accounts for market trends and firm risk, and improves the chances of isolating the effect of specific events (Campbell, Lo and MacKindley 1997). To estimate the coefficients α_i (average return of the firm compared with the market average) and β_i (sensitivity of its return to the market return or risk of the stock), I used ordinary least squares (OLS) with the 200 trading days in the estimation, which correspond to the interval [-240, -41] according to daily return data from CRSP. Formally:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + e_{it},$$

where R_{it} is the return on the stock of company *i* on day *t*, α_i is the intercept, β_i is the systematic risk of stock i, R_{mt} is the daily return of the equally weighted CRSP market portfolio, and e_{it} is the daily risk-adjusted residual for firm i. The corresponding estimated return on the stock for firm i on day t is given by:

$$\hat{R}_{it} = \alpha_i + \beta_i \times R_{mt}.$$

Next, I calculated the abnormal daily return (AR) of company *i* on day t as follows:

$$AR_{it} = R_{it} - \hat{R}_{it}.$$

Finally, I computed the cumulative abnormal returns (CARs) for each time interval by summing up the abnormal returns within the specific time window [-1,0].

$$CAR(-1,0) = \sum_{t=-1}^{0} A\overline{R}_t$$

3.3.2.2. Independent Variables.

Previous research defines organizational slack as *"The disparity between the resources available to the organization and the payments required to maintain the coalition"* (Cyert & March, 1963, p. 36) or "*The difference between the existing resources and activated demands"* (March & Olsen, 1976, p. 87). Therefore, slack represents excess resources beyond what is needed for "normal," efficient operations, and its existence enables companies to pursue various options, including introducing new products or entering new sectors or markets. Such projects are less likely in a resource-constrained environment. Some authors thus argue that managers need slack to innovate (Penrose, 1959; Cyert and March, 1963) and that it facilitates creative behavior and innovative experimentation (Hambrick and Snow, 1977; Bourgeois, 1981). I use two existing measures of available slack (Bourgeois, 1981) or unabsorbed slack (Singh, 1986), which are immediately available and not yet assimilated into the technical design of the organization. First, following previous literature, I used the quick ratio (Baucus and Near, 1991; Combs and Ketchen, 1999b; Davis and Miziuchi, 1999; Palmer and Wiseman, 1999; Smith et al. 1991), which reflects the company's ability to meet its short-term obligations with its most liquid assets. The higher the ratio, the better the position of the company. I computed this ratio as (current assets – inventories)/current liabilities. Next, I divided the observations at the median, into *quick_undermedian* and *quick_abovemedian.* As a robustness check, I also differentiated observations that were below the 25th percentile *(quick1)* and those above the 75th percentile *(quick3).* Second, another measure commonly used to reflect available slack is the current ratio (CR) (Ahuja, 2000; Bergh, 1997; Bergh and Lawless, 1998; Bromiley, 1991; Bolton, 1993; Chang and Singh, 1999; Dailey, 1995; Dailey and Dalton, 1994; Hambrick et al. 1996; Hitt et al. 1996; Hoskisson and Jonhson, 1992). It indicates the company's ability to meet short-term debt obligations, computed as current assets/current liabilities. If the firm's current assets are more than twice its current liabilities, the company is financially strong. If current liabilities exceed current assets, the company may have problems meeting its short-term obligations. Similar to the quick ratio, I divided these observations at the median: *cr_undermedian* and *cr_abovemedian.* As a robustness check, I again differentiated observations that were below the 25th percentile *(CR1)* and those above the 75th percentile *(CR3)*

To distinguish between licensing agreements within the same or across different sectors, I used a dummy variable *(SSIC)*, equal to 1 if the four-digit standard industrial classification (SIC) of the licensor is identical to the four-digit SIC of the licensee, and 0 otherwise. The four-digit SIC code accounts for the division, the major group, and the industry group of each company.[31] It was acquired through Compustat database.

Finally, to classify each licensor as a leader or follower in a specific sector, I computed its market share, as the ratio between the licensor's net sales and total net sales in the licensor's industry. Industry net sales represented the sum of all net sales by companies operating in the same four-digit SIC code in year t. Following Giroud and Mueller (2011), I included all available Compustat firms in the same SIC code but excluded firms for which net sales were missing. Then, after computing the market share of each licensor in each year, I distinguished companies with high *(LEADER)* or low *(FOLLOWER)* market shares, using a dummy variable. This variable equaled 1 if the licensor was one of the three companies with the highest market share in the four-digit SIC code at year t, and 0 otherwise.

[31] The SIC codes are grouped into progressively broader classifications; four digits represent a specific division, three digits correspond to the industry group, and two digits indicate the major group.

3.3.3. Methodology

3.3.3.1. Event Study.

To capture the stock price reaction to licensing announcements, I ran an event study and examined the stock price reaction by analyzing the average CARs during the event window. These CARs captured how much the stock price deviated from its expected value on the day of the licensing announcement. This methodology relies on the assumption that stock markets are efficient and that prices perfectly reflect all public information related to the prospects of the company. Thus, the effect of a specific event should be reflected almost immediately in the stock market. That is, when an event occurs, the market updates its forecast, causing a shift in market value.

To avoid including unrelated events that might influence stock returns, the event window needs to be sufficiently narrow (Gulati et al. 2009). A common approach sets the event day (day 0) as the day of the announcement and also considers the possibility that the event might have happened on the previous day, before the stock market closed (day -1) (MacKinlay, 1997). Previous research has indicated that a two-day window is more effective than longer windows for capturing stock market reactions (Crutchley et al., 1991). However, as a robustness check, I also considered the [-1,1] and [-3,3] windows.

Prior studies of licensing (Anand and Khanna, 2000b; Walter, 2012), alliances (Merchant and Schendel, 2000; Kale et al., 2002; Gulati et al. 2009), and joint ventures (Balakrishna and Koza, 1993; Park and Kim, 1997; Reuer and Koza, 2000) have employed CAR as an effective, market-based measure of firm performance. Moreover, prior research has found a high correlation (around 40%) between this variable and the long-term firm performance and value of the event (Koh and Venkatraman, 1991; Kale et al. 2002). Thus, to examine if the various contingencies I proposed have different impacts on the licensor's market value, I divided the sample into six cases and computed separate CARs for each: licensors with and without cash constraints (H1), licensing agreements between companies that belong to the same and different sectors (H2), and licensors that are leaders or followers (H3). Next, in order to provide a deeper analysis, I computed the CARs for four interactions: (1) licensing agreements between companies that belong to the same sector + leaders, (2) licensing agreements between companies that belong to the same sector + followers, (3) licensing agreements between companies that belong to different sectors + leaders, and (4) licensing agreements between companies that belong to different sectors + followers.

3.3.3.2. Significance Tests.

To determine if the resulting mean CARs differed significantly from 0, I conducted three tests: two parametric (Patell Z test and crude dependence adjustment [CDA]) and one non-parametric (generalized sign Z). Parametric tests rely on the assumption that a firm's ARs are normally distributed. As I detail in the Appendix, the Patell Z Test (or standardized abnormal return test) thus estimates a separate standard error for each security event, assuming cross-sectional independence. The standardization ensures that each AR offers the same variance. Under the null hypothesis, this statistic converges to unit normal (see Linn and McConnell, 1983; Schipper and Smith, 1986; Haw, Pastena and Lilien, 1990). In contrast, the time-series standard deviation test, or CDA (Brown and Warner, 1985), uses a single variance estimate to reflect all pairwise correlations between ARs, thereby addressing cross-sectional dependence (see the Appendix). It is distributed as a Student t and approximately unit normal under the null hypothesis (see Dopuch, Holthausen and Leftwich, 1986; Brickley, Dark and Weisbach, 1991).

In addition to these parametric tests, I include a non-parametric test to acknowledge that daily stock data are not normally distributed (Fama, 1965; Mandelbrot, 1963; Officer, 1972) and compare the test conclusions (Campbell et al. 1997). The generalized sign test (see the Appendix) uses a normal approximation of the binomial distribution and adjusts for the fraction of positive abnormal returns in the estimation period instead of assuming 0.5. The null hypothesis is that the fraction of positive returns is the same as in the estimation period (Sanger and Peterson 1990; Singh, Cowan and Nayar 1991; Chen, Hu and Shieh 1991). A more detailed explanation of the generalized sign test is available from Sprent (1989) or Cowan (1992).

3.3.3.3. Significance of the Differences Between Groups.

After analyzing the significance of the mean CAR, a necessary next step is to discern if the differences between the mean CAR of the compared groups are significant. I used the T-Statistic to compare the means between two groups, as I detail in the Appendix. The null hypothesis states that the difference between the means is zero. Therefore, if this null hypothesis can be rejected, there must be a significant difference between the two samples. The same process repeated for event windows equal to (-1,1) and (-3,3).

3.4. Results

3.4.1. Descriptive Statistics and Main Results

Table 1 provides the descriptive statistics and the correlations for the variables of interest. On this table we can see that the mean of CARs using a three-day event window (-1,1) is more than one percentage point greater than the mean CARs using a two-day event window (-1,0). Regarding the differences between the quick ratio and the current ratio, we can observe that they are quite similar. In particular, quick ratio is a little smaller because by definition its numerator is reduced by inventories' variable, not as in the current ratio. Regarding the correlations, we can observe that the correlation between CARs using a two event window and CARs using a three-event window is equal 0.59. However, this does not represent any problem because I am not using both simultaneously. Also, we can observe that correlations between market share and the financial variables (quick ratio and current ratio) are negative and quite high (-0.3101 and -0.3034, respectively).

[Insert Table 1 around here]

Table 2 contains a summary of the results for each daily return and the whole population of licensing agreements (N = 260) and Figure 2 represents them graphically. On the day of the announcement (day 0), mean ARs were positive (2.46%) and statistically significant at the 1% level for all tests. By day 1, the mean of ARs remained positive (0.88%) and was statistically significant in the parametric tests. However, no significant effects emerged in the immediate previous or posterior days, as Table 3 shows in relation to the mean CAR variable. For the three event windows, each of which contains the day of the licensing agreement—(-1,0), (-1,1) and (-3,3)—the mean CARs were positive and statistically significant for all tests at the 1% level. However, for the event windows that did not contain the day of the announcement—(-30,2) and (2, 30)—the mean CAR was positive in both cases but not so significant.

[Insert Table 2 and Table 3 around here]

Table 4 contains the resulting mean CAR and test statistics for each subsample using a event window of (-1,0). The precision weighted cumulative average abnormal return (CAAR), defined as a weighted average of the original CARs, provides a means to report an average standardized cumulative abnormal return (average SCAR). For each group, I also indicate the number of securities with positive and negative average abnormal returns.

[Insert Table 4 around here]

In line with H1 regarding the effect of cash constraints, the mean CARs resulting from the announcement of a licensing agreement were lower when the licensor had cash flow problems than when it did not, whether I used the current ratio *"undermedian/overmedian"* grouping (1.33% vs. 2.24%), quick ratio *"undermedian/overmedian"* grouping (1.10% vs. 2.65%), quick ratio percentile comparisons (1.04% vs. 3.55%), or the current ratio percentile comparisons (1.84% vs. 2.70%). The resulting mean CARs also were statistically significant in all the tests at least at the 5% level, with the exception of the current ratio (>75%) under the generalized sign test.

I also found support for same-sector benefits, as predicted in H2. Specifically, the mean CAR resulting from announcing a licensing agreement increased when both companies belonged to the same sector rather than different sectors (7.27% vs. 1.53%). The positive mean CARs were statistically significant for both the Patell Z and CDA test at the 0.1% level. For the generalized sign Z, announcements between companies in the same SIC were significant at the 0.1% level, and mean CARs resulting from announcements between companies from different sectors were significant at the 1% level.

Finally, the data corroborated H3, in that the mean CAR resulting from the announcement of licensing agreements was greater when licensors were followers instead of leaders in the sector (0.61% vs. 3.86%). For followers, the mean CAR was statistically significant under the Patell Z and CDA tests at the 0.1% level and under the generalized sign test at the 0.01 level. For leaders, it was statistically significant at the 5% level (Patell Z and generalized sign Z) or 1% level (CDA).

Table 5 provides the Student t-test results, to determine if the difference in means between the groups is statistically significant. All the mean differences were statistically significant, except for the cases related to the current ratio, for which the difference of mean CARs were not significant. For the quick ratio, the difference between the *abovemedian* group and the *undermedian* group was significant at 10% level. Regarding the sector, the mean CAR differences between licensing in the same sector and licensing in a different sector were significant at the 5% level. Regarding the position of the company in its sector, the difference between leader and follower mean CARs was significant at the 10% level.

3.4.2. Robustness Checks

As a robustness check, I computed the mean CARs for each subgroup for two additional event windows, (-1,1) and (-3,3); in Tables 6 and 7, respectively, the main results are again corroborated. However, two main changes are notable: (1) the mean CARs of the fourth quartile ratio became significant at the 0.001 level (previously was not significant) and (2) the mean CARs for leaders were not significant in the CDA test or generalized sign Z test (previously significant at the 10% and 5% levels, respectively). These changes appear in both Tables 6 and 7.

[Insert Table 6 and Table 7 around here]

Also, to show that the results are not influenced either by the choice of the model or by the choice of reference portfolio, I ran different models: Market Adjusted Model and with another reference portfolio: Value Weighted Index Portfolio. Therefore, Table 8 reports the results of the event study for each subsample using the Market Adjusted Returns Model and using, as in the previous case, the Equally Weighted Index. Under this scenario, CARs for each subsample are positive and statistically significant under the three significance tests. Table 9 reports the results of the event study for each subsample using, as in the first case, the Market Model and, as novelty, the Value Weighted Index. Also under this scenario, CARs were positive and statistically significant under the three significance tests. Therefore, results are not affected by neither the choice of the model nor the choice of the reference portfolio.

[Insert Table 8 and Table 9 around here]

3.4.3. Interaction Effects

Results from previous hypotheses have shown that companies that license out to a company in the same sector obtain more benefits (H2) and that leaders benefit less than followers (H3). However, as the former one gives us insights regarding the choice of the sector and the latter one regarding the relative position of the company in the sector, these two supported hypotheses are not mutually exclusive. Rather, in conjunction they represent the licensing trade-off that Fosfuri (2006) describes. On the one hand, in terms of appropriation, companies that license out the technology to the same sector will increase their benefits more than companies that license out to a different one. On the other hand, the potential cost of imitation would be higher if the companies are in the same sector: given the similarities of the companies that belong to the same sector, it would be easier for companies to invent around the licensed technology and to imitate the licensor in the product market reducing licensors' benefits as much as the higher is their market share. Therefore, as the appropriation of benefits will not just depend on the licensees' sector but on both: licensees' sector and relative position of the licensor in the product market. I explore their combined effect on CARs in conjunction, considering four cases.

First, among companies that license to same-sector companies, I would expect followers to appropriate more value from licensing than leaders. Recall that followers have little to lose due to imitation by competitors, and they already have some bargaining power because they are negotiating in a context marked by low information asymmetries. Although leaders have similar bargaining power due to low information asymmetries, the cost of imitation could be high, so they likely appropriate fewer benefits from licensing.

Second, for companies that license out to different sectors, I would expect again that followers appropriate more value from licensing than leaders. However, this difference should not be as pronounced as in the previous case, because all licensors confront high information asymmetries and depend on their licensee to earn benefits from their previous investments. Followers still have little to lose if the licensee decides to imitate them, but now they lack any bargaining power. Licensors that are leaders suffer both the information asymmetry and the potential cost of imitation. I recognize that this possibility is relatively unlikely, because licensees would incur massive investments to compete directly with a licensor, yet licensees plausibly could imitate licensors, which would reduce the licensor's benefits.

[Insert Table 10 around here]

In Table 10, following the Market Model and using the Equally Weighted Index, the mean CARs of leaders were much lower than those of followers when they licensed in the same sector (0.73% vs. 8.46%), though the impact was statistically significant when licensors were followers. Furthermore, the difference between the mean CAR when licensors were leaders versus followers was much lower if they belonged to different sectors (0.59% and 2.19% vs. 0.73% and 8.46%). Therefore, we can see that the best situation to appropriate benefits from licensing is when licensees belong to the same sector than licensors and when they are followers (CARs=8.46%). On contrary, appropriation is very low when licensor and licensee belong to different sectors and licensors are leaders (CARs=0.73%). This conclusion is still corroborated under two additional specifications: 1) Market Adjusted Return Model, using the Equally Weighted Index Model and 2) Market Model, using the Value Weighted Index.

3.5. Summary and Conclusion

This article proposes that the licensor's appropriation capacity is a function of two aspects: The licensor's bargaining power (determined by their cash constraints and the existence of information asymmetries between parties) and the potential cost of imitation. The data confirms that these factors influence the licensor's appropriation capacity, in terms of market value, in significant and distinct ways. Firstly, in line with previous research which indicates that financial constraints erode the bargaining power of companies (Lerner and Merges, 1993; Aghion and Tirole, 1994), I show that the appropriation capacity of the licensor is lower when companies face cash constraints than when they do not. Also, in accordance with the research that demonstrates that information asymmetries reduce the bargaining power of companies (Chattejee & Samuelson, 1983), I find that licensors can better appropriate benefits from licensing when they license out in the same sector (i.e., lower information asymmetries) than when they license out to another sector (higher information asymmetries). Furthermore, I also state that the impact of imitation grows stronger when the market share of the licensor increases (Arora & Fosfuri, 2003) by demonstrating that the licensors that are followers appropriate more benefits from licensing than the licensors that are leaders do. Additionally, I prove that the best situation to appropriate benefits from licensing, in terms of market value, is when the licensees belong to the same sector as the licensors, and when they are followers. Finally, appropriation is very low when the licensor and the licensee belong to different sectors and the licensors are leaders.

This paper does have some limitations. From an empirical point of view, I am measuring licensor's appropriation capacity under the assumption that the total generated returns are orthogonal to the cumulative abnormal returns and, therefore, any increase in the licensor value could be just generated by an increase in the appropriation capacity. However, I am conscious that an increase in CARs could be the result of an increase in the licensors' appropriation capacity or of an increase in the level of the total generated returns. Also, this study only contemplates the impact that licensing out has on the stock market. Ideally, I should know how much the licensors would benefit, in terms of market value, compared with licensees. This would allow me to understand the whole impact of announcing a licensing agreement. I explain how to introduce the licensee's aspect in the section of future research. Furthermore, a potential concern regarding the data collection is the possibility that I did not capture the entire history of licensing agreements for all the companies in my study. However, focusing on companies from the same country and with the same characteristics (public companies with most patents granted) I expect to reduce the chances of obtaining more news from one company than from another. As Schilling (2009, p.258) claimed *"even though each database only captures a sample of alliance activity, it may yield reliable results for many-if not all- purposes".* However, in this study, the fact that I am not observing all the licensing agreements would go against my research. Specifically, if I am not identifying all the licensing agreements, nor am I considering all these "increases" in the stock market. In consequence, the "normal" returns used to make the prediction should be greater than in the case of identifying the whole population and, therefore, obtaining significant "abnormal returns" should be more difficult. Finally, as far as it concerns the generality of the results, they cannot be applied to wider populations of companies. Licensing has still not spread to all industries or countries. Rather, the companies for which these findings hold (1) have more patents to trade in markets for technology, (2) belong to industries in which licensing agreements are common, (3) operate in the most developed (U.S.) environment for markets for technology, and (4) are public companies, subject to the pressures of the stock market. The results do not apply to other companies that do not satisfy these characteristics.

Despite these limitations, this study sheds a new light on some important and relatively unexplored topics. In particular, it provides more evidence of the value of appropriation in licensing agreements. To the best of my knowledge, only Walter (2012) has considered the licensing benefits appropriated by each partner. This study also explicates the bargaining power in the context of licensing agreements, by proposing and confirming that it is a function of two factors. Furthermore, this article proposes another potential explanation for why large firms are not really active in the market for technology, mainly, the small effect on their market value obtained from licensing out (CAR = 0.66% for the leaders with a high market share versus 3.86% for the followers). Finally, this study empirically evidences, through market value variations, how both effects of the licensing trade-off interact.

From a practical point of view, my study provides some strategic insights that managers could take into account. In recent years, the company stock market measures have increased in importance. External observers use them to proxy for the firm's future performance and the board of directors use them to evaluate and compensate managers (Degeorge et al. 1999). Therefore, in order to maintain their jobs, earn higher salaries, and enhance their reputation, managers also prefer to make decisions that increase the stock market measures. By analyzing the situations that generate stronger/weaker impacts in the stock market, this study offers the managers some guidance in their strategic decisions. First of all, managers should realize that licensing decisions in cash-constrained situations will appropriate fewer benefits in terms of market value. Secondly, the stock market responds better to a licensing decision if the licensee belongs to the same sector. Another same-sector company's desire to license the technology offers a signal of the superiority of the licensor, the inability of the licensee to compete with the technology, and/or the likely standardization of this technology throughout the sector. Therefore, companies can increase their benefits by licensing in the same sector, earning immediate revenues and a heightened stock market value. However, this significant stock market increase occurs only if the risk of imitation resulting from licensing is not too high. For managers of firms that are leaders in their sector, this study reveals that the impact of licensing on the stock market is almost nonexistent. Therefore, for them, it is better not to license out; unless the licensing payments overcome the potential cost of imitation. On the contrary, this paper suggests to the managers of companies that are followers to license out their proprietary technologies. Followers that are able to license out are sending a signal of reputation, quality and prospects of growth. Finally, this paper reveals, that the best situation to appropriate benefits in terms of market value is to license out the technology to a company that belongs to the same sector while being a follower.

Regarding future research, my plan is the following. First of all, I would like to introduce the licensee's analysis aspect in order to capture the total value created and the relative value appropriated by each part. Therefore, knowing the percentage of increase caused by each licensing agreement in the licensor and the licensee's market value and also the market value of each involved company (the price of each share multiplied by the number of outstanding shares), I will be able to know the total value created by each licensing agreement as well the value appropriated by each part in relative terms. As this analysis will imply having a cross sectional data, I can also use some control variables to try to isolate the effect in the stock market and to rule out other possible explanations.

Finally, further research should continue to analyze additional organizational and industrial characteristics that might affect the distribution of the bargaining power in licensing agreements, as well the consequences of this distribution. One possible extension might be to determine the consequences of a low bargaining power on decisions about the control over the company after the agreement. For instance, do companies with less bargaining power accept key conditions, such as investments in equity, grant back clauses or votes in the board of directors?

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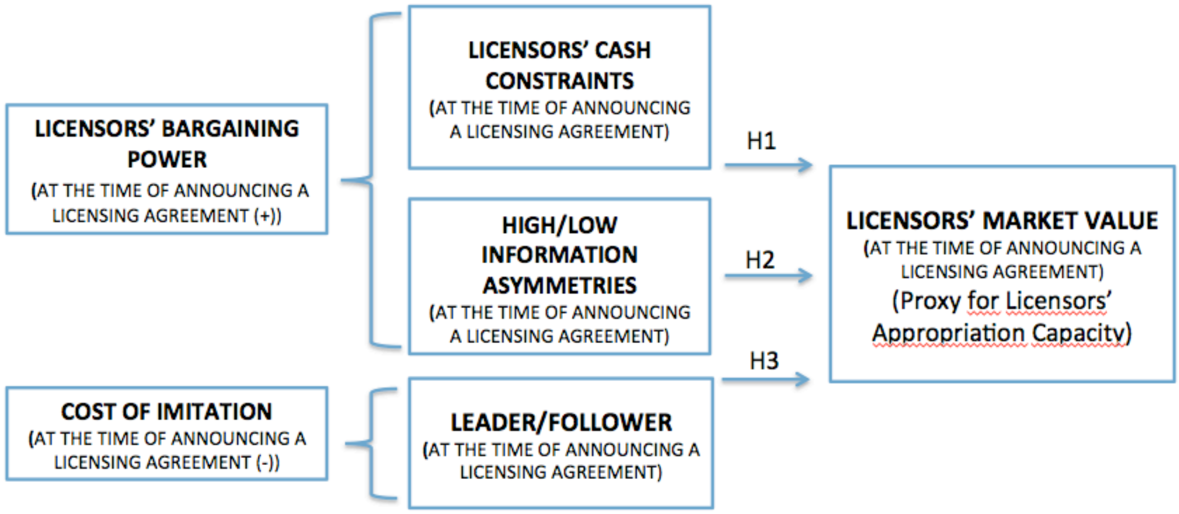
3.7. Appendix

3.7.1. Figure 1



3.7.2. Tests

The Patell Z Test (or standardized abnormal return test) estimates a separate standard error for each security event, assuming cross-sectional independence. The standardization ensures that each AR offers the same variance. Patell test statistic is asymptotically N(0,1) distributed under the null hypothesis (see Linn and McConnell, 1983; Schipper and Smith, 1986; Haw, Pastena and Lilien, 1990).

Patell (1976) test statistic is defined as:

$$t_{patell} = \sqrt{\frac{n(L_1 - 4)}{L_1 - 2}}\,\overline{SCAR}_{\tau}$$

where $L_1 = T_1 - T_0$ is the length of the estimation period,

$$\overline{SCAR}_{(\tau_1,\tau_2)} = \frac{CAR_i(\tau_1,\tau_2)}{S_{CAR_i(\tau_1,\tau_2)}}$$

is the average standarized CAR. This test is proven to be powerful when the condition of cross sectional Independence of abnormal returns is not violated.

The time-series standard deviation test, or Crude Dependence Adjusted Test, CDA, (Brown and

Warner 1980, 1985) compensates for potential dependence of returns by estimating the standard deviation using the time series of sample mean returns from the estimation period. If the estimated abnormal returns are normally, independent and identically distributed, this test statistic is approximately standard normal under the null hypothesis (see Dopuch, Holthausen and Leftwich, 1986; Brickley, Dark and Weisbach, 1991).

The CDA test for day zero is defined as:

$$t_{CDA} = \overline{u}_t / s(\overline{u}_t)$$

where $\overline{u}_t$ is the equal-weighted portfolio mean abnormal return on day t, i.e.,

$\overline{u}_t = (1/N)\sum_{i=1}^{N} u_{it}$, and the standard deviation of $\overline{u}_t$ is

$s(\overline{u}_t) = \sqrt{(1/200)\sum_{t=-240}^{-40}(\overline{u}_t - u)}$ where $u = (1/201)\sum_{t=-240}^{-40}\overline{u}_t$.

The Generalized Sign Test (Cowan, 1982) uses a normal approximation of the binomial distribution and adjusts for the fraction of positive abnormal returns in the estimation period instead of assuming 0.5. The null hypothesis is that the fraction of positive returns is the same as in the estimation period (Sanger and Peterson 1990; Singh, Cowan and Nayar 1991; Chen, Hu and Shieh 1991).The generalized sign test examines whether the number of stocks with positive cumulative abnormal returns in the event window exceeds the number expected in the absence of abnormal performance. The number expected is based on the fraction of positive abnormal returns in the 200 day estimation period,

$$\hat{p} = \frac{1}{n}\sum_{j=1}^{n}\frac{1}{200}\sum_{t=E_1}^{E_{200}} S_{jt}$$

where

$$S_{jt} = \begin{cases} 1 \text{ if} & AR_{jt} > 0 \\ 0 & \text{otherwise} \end{cases}$$

This test statistic uses the normal approximation to the binomial distribution with parameter $\hat{p}$. Define *w* as the number of stocks in the event window for which the cumulative abnormal return $CAR_{j(D_1,D_d)}$ is positive.

The Generalized Sign Test statistic is:

$$Z_G = \frac{w - n\hat{p}}{[n\hat{p}(1-\hat{p})]^{1/2}}$$

In order to study if the mean CAR of the compared groups is significant, I used the T-test that is defined in the following way:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{x_1x_2} \cdot \sqrt{\frac{2}{n}}}$$

where $\bar{X}_1 - \bar{X}_2$ is the difference between the means of the two groups, $s_{x_1x_2} = \sqrt{\frac{1}{2}(s_{x_1}^2 + s_{x_2}^2)}$ is the pooled standard deviation, of group one and group two and $s_{x_1}^2$ and $s_{x_2}^2$ are the estimators of the variances of the two samples. The null hypothesis states that the difference between the means is zero. Therefore, if this null hypothesis can be rejected, there must be a significant difference between the two samples.

3.8.Tables

Table 1. Descriptive Statistics and Correlations

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*	*CAR11pc*	*CAR01pc*	*Market Share*	*Same SIC*	*Quick ratio*	*Current ratio*
CAR11pc	260	4.030421	18.83941	-28.76	227.02	1					
CAR01pc	260	2.926858	15.96793	-26.61	227.13	0.5922	1				
Market share	253	9.690217	19.09417	0	92.13502	-0.1065	-0.0996	1			
Same SIC	260	0.1992337	0.4001915	0	1	0.0984	0.1394	-0.2082	1		
Quick Ratio	245	3.724989	4.165635	0.3347453	30.08364	0.0986	-0.0298	-0.3101	0.0921	1	
Current Ratio	245	3.935711	4.101579	0.3871703	30.08364	0.0968	-0.0341	-0.3034	0.0876	0.9973	1

Table 2. Daily Mean Abnormal Returns and Test Statistics for all licensing announcements *(N = 260)*

Day	N	Mean Abnormal Return	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
-30	260	-0.13%	121:139	-0.362	-0.518	-0.25
-29	260	0.59%	135:125)	1.941*	2.379**	1.489$
-28	260	0.04%	127:133	0.678	0.173	0.495
-27	260	-0.11%	119:141	-1.009	-0.443	-0.499
-26	260	-0.08%	123:137	-0.186	-0.327	-0.002
-25	260	0.05%	134:126)	1.322$	0.219	1.365$
-24	260	-0.24%	115:145	-1.872*	-0.976	-0.995
-23	260	0.44%	132:128	2.313*	1.775*	1.116
-22	260	0.07%	128:132	-0.118	0.284	0.619
-21	260	-0.17%	121:139	-2.176*	-0.692	-0.25
-20	260	-0.22%	122:138	-0.659	-0.913	-0.126
-19	260	-0.05%	122:138	0.318	-0.22	-0.126
-18	260	0.59%	123:137	2.544**	2.401**	-0.002
-17	260	-0.02%	125:135	-0.321	-0.079	0.247
-16	260	0.58%	135:125)	2.480**	2.366**	1.489$
-15	260	-0.32%	119:141	-0.669	-1.284$	-0.499
-14	260	-0.04%	119:141	-0.242	-0.182	-0.499
-13	260	-0.09%	120:140	-0.92	-0.357	-0.374
-12	260	0.32%	140:120>	1.051	1.286$	2.110*
-11	260	-0.05%	130:130	-0.392	-0.184	0.868
-10	260	0.29%	138:122>	1.485$	1.191	1.861*
-9	260	0.33%	134:126)	1.942*	1.355$	1.365$
-8	260	0.24%	122:138	0.989	0.994	-0.126
-7	260	0.34%	127:133	1.086	1.384$	0.495
-6	260	-0.12%	120:140	-1.128	-0.5	-0.374
-5	260	0.18%	125:135	1.063	0.735	0.247
-4	260	-0.21%	123:137	-1.2	-0.843	-0.002
-3	260	0.35%	133:127	2.186*	1.404$	1.24
-2	260	-0.37%	107:153<	-1.654*	-1.493$	-1.989*
-1	260	0.22%	126:134	0.937	0.897	0.371
0	260	2.46%	154:106>>>	9.615***	10.004***	3.849***

1	260	0.88%	118:142	3.210***	3.577***	-0.623
2	260	-0.07%	126:134	0.496	-0.299	0.371
3	260	-0.13%	119:141	-0.974	-0.523	-0.499
4	260	0.08%	121:139	0.458	0.315	-0.25
5	260	-0.13%	116:144	-0.009	-0.537	-0.871
6	260	0.16%	125:135	0.502	0.657	0.247
7	260	0.08%	110:150(	0.323	0.34	-1.617$
8	260	0.34%	128:132	2.869**	1.398$	0.619
9	260	-0.53%	112:148(	-2.974**	-2.153*	-1.368$
10	260	0.09%	143:117>>	1.514$	0.346	2.483**
11	260	0.24%	121:139	1.472$	0.979	-0.25
12	260	0.12%	136:124)	1.194	0.481	1.613$
13	260	-0.11%	130:130	-0.35	-0.461	0.868
14	260	0.16%	128:132	-0.309	0.634	0.619
15	260	0.12%	135:125)	1.607$	0.498	1.489$
16	260	-0.03%	134:126)	0.338	-0.113	1.365$
17	260	0.05%	120:140	0.205	0.213	-0.374
18	260	0.16%	120:140	1.054	0.663	-0.374
19	260	0.18%	128:132	1.232	0.735	0.619
20	260	-0.04%	135:125)	0.086	-0.146	1.489$
21	259	-0.07%	115:144	-0.067	-0.29	-0.938
22	259	-0.04%	124:135	-0.543	-0.178	0.182
23	259	-0.09%	120:139	0.552	-0.373	-0.316
24	259	-0.01%	131:128	1.136	-0.057	1.053
25	259	0.15%	122:137	0.689	0.621	-0.067
26	259	0.14%	132:127	0.882	0.559	1.177
27	259	0.14%	122:137	0.586	0.556	-0.067
28	259	-0.04%	112:147(	0.467	-0.175	-1.312$
29	259	-0.25%	116:143	-0.486	-1.037	-0.814
30	259	-0.25%	118:141	-0.97	-1.025	-0.565

Figure 2. Mean Abnormal Returns from 30 days before the licensing announcement until 30 days after the licensing announcement.

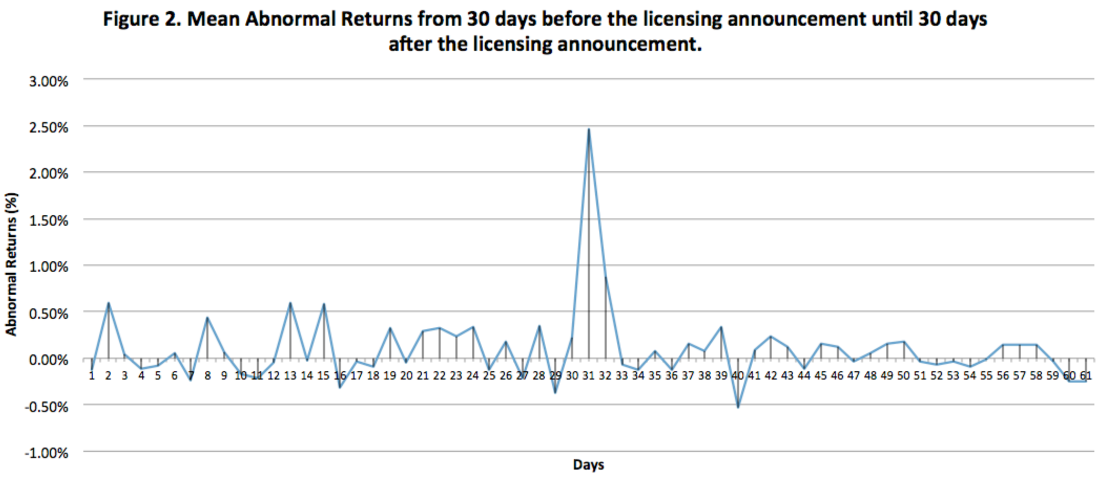


Table 3. Mean Cumulative Abnormal Returns and Test Statistics for Licensing Announcement (N =260): Market Model, Equally Weighted Index (-1,0) 41_200.

Days	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
(-1,0)	260	2.68%	1.60%	151:109>>>	7.462***	7.709***	3.476***
(-1,+1)	260	3.56%	2.09%	155:105>>>	7.946***	8.359***	3.973***
(-3,+3)	260	3.34%	2.10%	148:112>>>	5.222***	5.128***	3.104***
(+2,+30)	260	0.40%	1.66%	136:124)	2.040*	0.303	1.613$

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.

Table 4. Mean Cumulative Abnormal Returns and Test Statistics for Licensing Announcement Divided in Groups: Market Model, Equally Weighted Index (-1,0) 41_200

GROUP	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
Total Licensors	260	2.68%	1.60%	151:109>>>	7.462***	7.709***	3.476***
Quick Ratio_undermedian	123	1.10%	0.71%	72:51>	2.97**	3.000**	2.322*
Quick Ratio abovemedian	122	2.65%	2.44%	71:51>>	5.501***	4.45***	2.581**
Current Ratio undermedian	123	1.33%	0.96%	75:48>>	4.030***	3.791***	2.896**
Current Ratio abovemedian	122	2.42%	2.01%	68:54>	4.437***	3.986***	2.031*
Quick Ratio <25%	62	1.04%	0.72%	38:24>	2.230*	2.116*	2.018*
Quick Ratio >75%	61	3.55%	3.03%	36:25>	4.633***	3.765***	1.879*
Current Ratio <25%	60	1.84%	1.13%	37:23>	3.384***	3.521***	2.072*
Current Ratio >75%	61	2.70%	2.24%	33:28:00	3.179***	2.846**	1.092
Same Sic	52	7.27%	3.74%	34:18>>	7.506***	9.117***	2.633***
Diff Sic	208	1.53%	1.09%	117:91>>	4.591***	4.326***	2.57**
Leader	93	0.61%	0.52%	53:40>	2.082*	1.567$	1.65*
Follower	166	3.86%	2.73%	97:69>>	7.777***	7.905***	3.035**

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.

Table 5 . Cumulative Abnormal Returns: Differences of Means. Two-Sample T-statistic

	Obs	Mean (Diff)	Std. Err. (Diff)	95% Conf. Interval (Diff)		T-statistic (Diff)
Quick Undermedian-Quick Abovemedian	245	1.741461	1.014117	-0.2561206	3.739042	1.7172$
Current Ratio Undermedian- Current Ratio Abovemedian	245	1.431415	1.016111	-0.5700943	3.432924	1.4087
Same Sic - Diff Sic	260	-6.340883	2.447803	-11.16101	-1.520753	-2.5904*
Follower-Leader	260	3.545921	2.062227	-0.5150191	7.606861	1.7195$

The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels

Table 6. Mean Cumulative Abnormal Returns and Test Statistics for Licensing Announcement Divided in Groups: Market Model, Equally Weighted Index (-1,1) 41_200

GROUP	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
Total Licensors	260	3.56%	2.09%	155:105>>>	7.946***	8.359***	3.973***
Quick Ratio_undermedian	123	1.19%	0.80%	73:50>>	2.729**	2.643**	2.503**
Quick Ratio abovemedian	122	4.57%	3.94%	77:45>>>	7.247***	6.264***	3.670***
Current Ratio undermedian	123	1.52%	1.10%	75:48>>	3.766***	3.536***	2.869**
Current Ratio abovemedian	122	4.23%	3.44%	75:47>>>	6.205***	5.702***	3.302***
Quick Ratio <25%	62	1.18%	0.89%	36:26)	2.249*	1.959*	1.510$
Quick Ratio >75%	61	4.71%	4.21%	41:20>>>	5.266***	4.080***	3.162***
Current Ratio <25%	60	1.66%	1.15%	35:25)	2.805**	2.587**	1.555$
Current Ratio >75%	61	3.86%	3.49%	41:20>>>	4.047***	3.316***	3.144***
Same Sic	52	8.52%	4.84%	38:14>>>	7.924***	8.721***	3.745***
Diff Sic	208	2.32%	1.43%	117:91>>	4.923***	5.347***	2.57**
Leader	93	0.47%	0.46%	50:43:00	1.499$	0.984	1.028
Follower	166	5.30%	3.79%	104:62>>>	8.808***	8.873***	4.124***

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.

Table 7. Mean Cumulative Abnormal Returns and Test Statistics for Licensing Announcement Divided in Groups: Market Model, Equally Weighted Index (-3,3) 41_200.

GROUP	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
Total Licensors	260	3.34%	2.10%	148:112>>>	5.222***	5.128***	3.104***
Quick Ratio_undermedian	123	1.97%	1.35%	74:49>>	2.994**	2.868**	2.683**
Quick Ratio abovemedian	122	3.42%	3.08%	68:54>	3.712***	3.068**	2.037*
Current Ratio undermedian	123	2.27%	1.51%	76:47>>	3.384***	3.457***	3.05**
Current Ratio abovemedian	122	3.12%	2.81%	66:56>	3.320***	2.748**	1.668*
Quick Ratio <25%	62	1.51%	1.11%	40:22>>	1.836*	1.645*	2.526**
Quick Ratio >75%	61	3.43%	3.67%	38:23>>	3.003**	1.949*	2.393**
Current Ratio <25%	60	2.88%	1.79%	41:19>>>	2.856**	2.946**	3.105***
Current Ratio >75%	61	2.64%	2.97%	38:23>>	2.258*	1.485$	2.374**
Same Sic	52	7.74%	4.72%	32:20>	5.055***	5.188***	2.078*
Diff Sic	208	2.24%	1.47%	116:92>>	3.312***	3.371***	2.431**
Leader	93	0.12%	0.38%	52:41)	0.809	0.172	1.443$
Follower	166	5.11%	3.88%	95:71>>	5.898***	5.6***	2.724**

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.

Table 8. Mean Cumulative Abnormal Returns and Test Statistics for Licensing Announcement Divided in Groups: Market Adjusted Returns, Equally Weighted Index (-1,0) 41_200.

GROUP	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
Total Licensors	260	2.68%	2.12%	147:113>>>	7.061***	7.549***	3.155***
Quick Ratio_undermedian	123	1.08%	0.87%	66:57)	2.658**	2.854**	1.405$
Quick Ratio abovemedian	122	2.72%	2.95%	73:49>>	5.342***	4.550***	2.990**
Current Ratio undermedian	123	1.26%	1.16%	69:54>	3.652***	3.515***	1.892*
Current Ratio abovemedian	122	2.53%	2.43%	70:52>>	4.344***	4.159***	2.500**
Quick Ratio <25%	62	0.91%	0.79%	39:23>	1.903*	1.884*	2.124*
Quick Ratio >75%	61	3.72%	3.70%	37:24>	4.456***	3.739***	2.298*
Current Ratio <25%	60	1.82%	1.47%	36:24>	3.183***	3.385***	1.947*
Current Ratio >75%	61	2.88%	2.60%	35:26>	3.081**	2.871**	1.762*
Same Sic	52	7.40%	5.12%	31:21>	7.397***	9.104***	1.858*
Diff Sic	208	1.50%	1.40%	116:92>>	4.197***	4.066***	2.599**
Leader	93	0.55%	0.55%	52:41)	1.711*	1.375$	1.604$
Follower	166	3.89%	3.39%	94:72>>	7.552***	7.861***	2.668**

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.

Table 9. Mean Cumulative Abnormal Returns and Test Statistics for Licensing Announcement Divided in Groups: Market Model, Value Weighted Index (-1,0) 41_200.

GROUP	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Positive: Negative	Patell Z	Portfolio Time-Series (CDA) t	Generalized Sign Z
Total Licensors	260	2.85%	1.62%	155:105>>>	7.785***	7.976***	3.843***
Quick Ratio_undermedian	123	1.12%	0.70%	76:47>>	3.023**	3.046**	2.909**
Quick Ratio abovemedian	122	2.98%	2.57%	72:50>>	5.882***	4.881***	2.738**
Current Ratio undermedian	123	1.29%	0.92%	78:45>>>	4.062***	3.672***	3.313***
Current Ratio abovemedian	122	2.81%	2.18%	70:52>>	4.839***	4.522***	2.331**
Quick Ratio <25%	62	0.95%	0.60%	39:23>	1.943*	2.020*	2.212*
Quick Ratio >75%	61	4.07%	3.21%	36:25>	4.900***	4.118***	1.888*
Current Ratio <25%	60	1.73%	1.00%	38:22>	3.114***	3.408***	2.296*
Current Ratio >75%	61	3.16%	2.41%	34:27)	3.370***	3.153***	1.350$
Same Sic	52	7.71%	3.79%	34:18>>	7.776***	9.547***	2.619**
Diff Sic	208	1.63%	1.11%	121:87>>	4.817***	4.579***	2.987**
Leader	93	0.73%	0.60%	56:37>	2.525**	1.994*	2.167*
Follower	166	4.05%	2.75%	98:68>>>	7.842***	7.994***	3.109***

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.

Table 10. Interaction Effects: Mean Cumulative Abnormal Returns and Test Statistics for Each Interaction Group.

Market Model, Equally Weighted Index (-1,0) 41_200							
GROUP	*N*	*Mean Cumulative Abnormal Return*	*Precision Weighted CAAR*	*Positive: Negative*	*Patell Z*	*Portfolio Time-Series (CDA) t*	*Generalized Sign Z*
Leader+Same Sic	7	0.73%	0.38%	05:02	0.542	0.867	1.248
Leader+ Diff Sic	86	0.59%	0.54%	48:38)	2.01*	1.462$	1.36$
Follower+Same Sic	44	8.46%	4.99%	28:16>	7.935***	9.323***	2.206*
Follower+Diff Sic	122	2.19%	1.82%	69:53>	4.307***	4.133***	2.215*
Market Adjusted Returns, Equally Weighted Index (-1,0) 41_200							
GROUP	*N*	*Mean Cumulative Abnormal Return*	*Precision Weighted CAAR*	*Positive: Negative*	*Patell Z*	*Portfolio Time-Series (CDA) t*	*Generalized Sign Z*
Leader+Same Sic	7	0.95%	0.50%	04:03	0.618	1.095	0.473
Leader+ Diff Sic	86	0.51%	0.55%	48:38)	1.603$	1.231	1.533$
Follower+Same Sic	44	8.94%	5.08%	29:15>>	8.135***	9.728***	2.502**
Follower+Diff Sic	122	2.20%	2.23%	68:54>	4.134***	3.988***	2.106*
Market Model, Value Weighted Index (-1,0) 41_200							
GROUP	*N*	*Mean Cumulative Abnormal Return*	*Precision Weighted CAAR*	*Positive: Negative*	*Patell Z*	*Portfolio Time-Series (CDA) t*	*Generalized Sign Z*
Leader+Same Sic	7	0.87%	0.48%	04:03	0.744	1.181	0.477
Leader+ Diff Sic	86	0.71%	0.61%	52:34>	2.414**	1.858*	2.117*
Follower+Same Sic	44	8.94%	5.08%	29:15>>	8.135***	9.728***	2.502**
Follower+Diff Sic	122	2.28%	1.80%	69:53>	4.263***	4.206***	2.123*

Notes: The symbols $,*,**, and *** denote statistical significance at the 0.10, 0.05, 0.01, and 0.001 levels, respectively, using a generic one-tailed test. The symbols (,< or),> etc. correspond to $,* and show the direction and significance of the generalized sign test.